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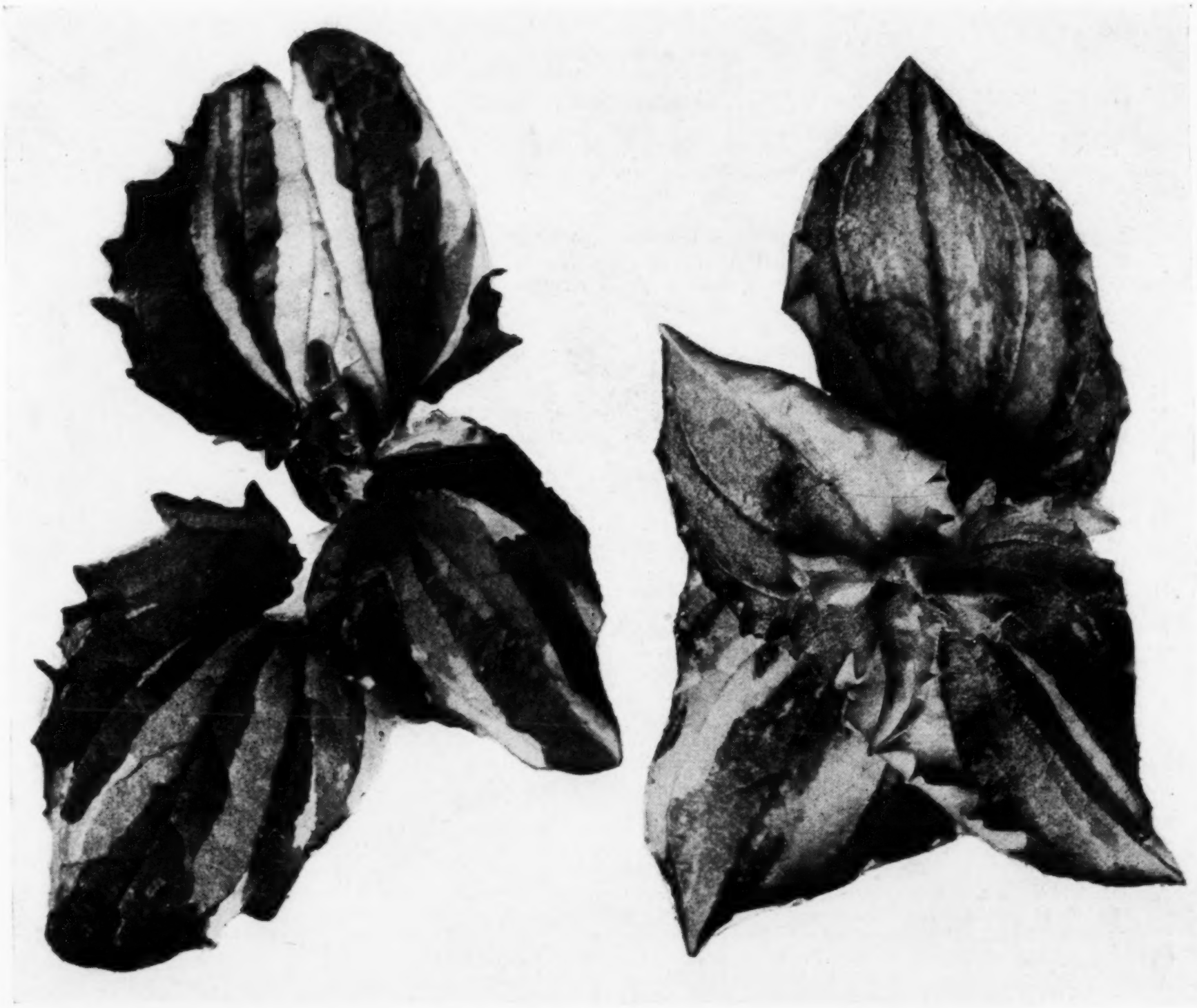

Variegated Leaves—A Plastid-borne Character

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George P. Weldon

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Proliferation of Dahlia
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APRIL, 1926 Vol. 17, No. 4

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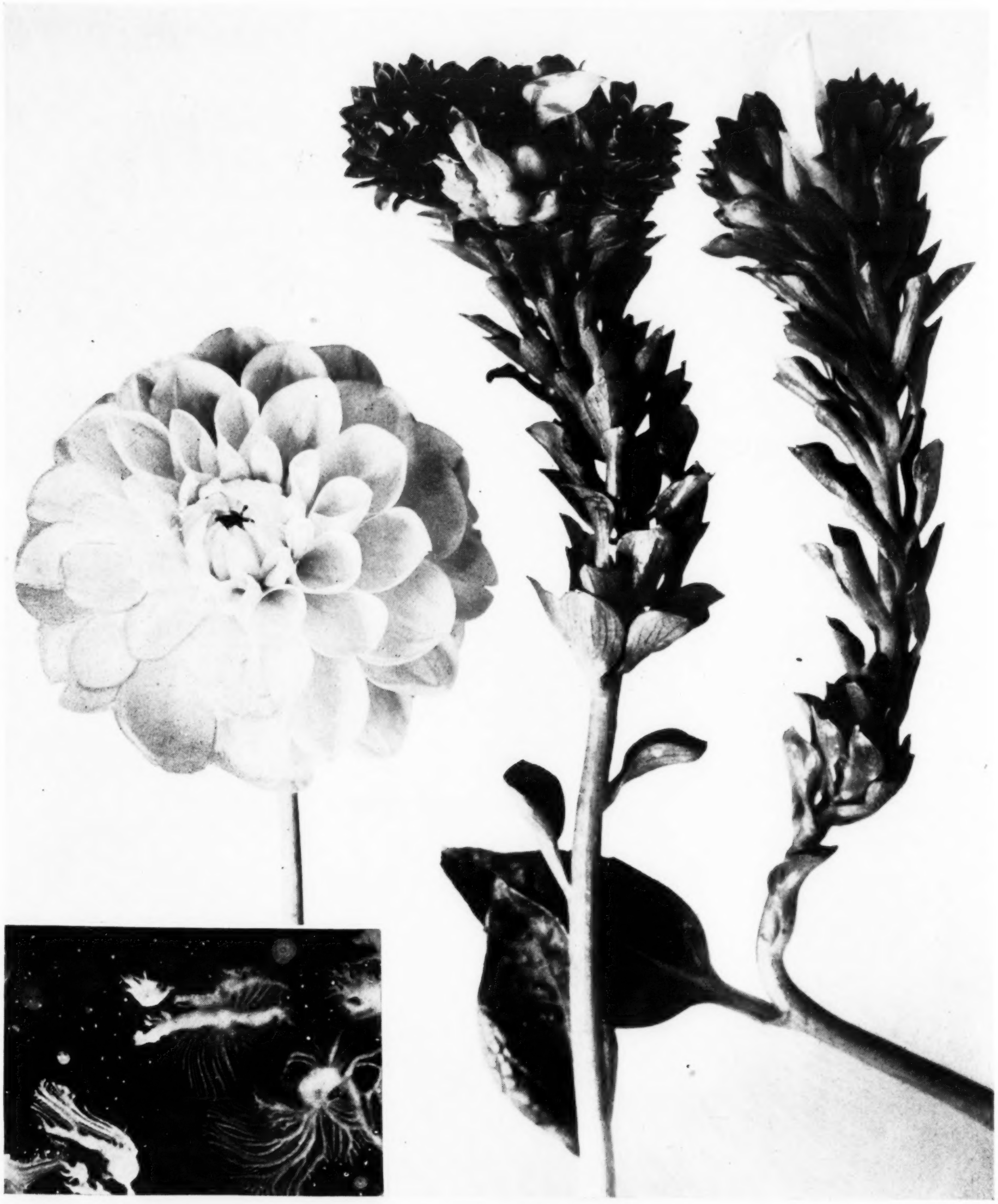


FASCIATION OF DAHLIA

Frontispiece

A full double pink Dahlia, one plant of which was fasciated as here shown. This was a large much branched very leafy plant. There were many floral axes stretched three to six inches and covered with green bracts. There were no normal flowers on this plant, but occasionally a few pink petals appeared, as on these two shoots. In addition to its excessive vegetative growth the plant differed visibly from its fellows only in having an injured main axis into which rainwater had penetrated. This cavity extending through several internodes was full of a mixed bacterial growth, and the fasciation is attributed to the action of ammonia and other bacterial by-products. Some of these fasciations were much more striking. One of them had seven centers of growth at its apex. Types of the colonies obtained on poured plates are also shown. (See insert.) There were at least three sorts, yellow colonies, round white colonies and irridescent branched ones. Unfortunately the cultures were lost before experimental inoculations could be made.

Erwin F. Smith.

INHERITANCE IN THE MONKEY-FLOWER*

A Genetic Study of Crosses between *Mimulus quinquevulnerus* *M. tigrinus* and *M. tigrinoides*

ARTHUR BROZEK

Plant Physiological Institute, Charles University, Prague, Czechoslovakia

IN the following report we will present a brief description of the main results of our breeding experiments with Mimulus, in which we had an excellent opportunity to study the changes and finally the genetical fixation or balance of many different forms in the progeny of three hybrids: phenomena which are not only of practical value, but are of great evolutionary importance as well.

We found in the three garden species of the genus *Mimulus* (Scrophulariaceae), *quinquevulnerus, tigrinus* and *tigrinoides* an extraordinarily suitable material for studying the above mentioned phenomena in the light of Mendel's law.[1] These three species were most probably derived, as all other garden species and their varieties, cultivated since about 1863 in Europe, from wild forms, spread over the different parts of Northern and Western America[2,3,4]. The three plants, with which our experiments started in 1911 and 1913 were probably hybrids, having been selected from a garden population and reared in the open air. They were quite different in a great number of characters, such as habit of growth, character of foliage (their leaves varying in extent of pilosity, and in serration), the size and shape of the petal spots, the size and the form of the whole flower, and many other physiological and morphological characters.

These plants are especially well suited for breeding experiments, for it was quite easy to get many successive generations by most strict self fertilization as well as by intercrossing. Nevertheless it must be said that autogamy (selfing) proved its bad effects in succeeding generations, but with unequal force in different lines. In some selfed lines the evil effects were evident much sooner than in others. On the other hand, cross fertilization has never had a bad effect, while regularly increasing the number of seeds in each fruit, even in the first hybrid generation. The number of seeds and seedlings coming from a single fruit was normally very great. Therefore, we easily get from 200 to 250 or more plants from each fruit.

Our experiments have been carried on continuously since 1911 in two botanical gardens of the Plant Physiological Institute, Charles University, Prague, Czechoslovakia. They were very extensive, especially in 1913, 1914, and 1915, containing about 3,000 individuals in the garden at "Albertov" and about 1,000 plants in the garden at "Slupi" (See Figure 1.)

Seed was sown every year early in May. All the seeds from a single fruit were sown separately, in a single pot. The seedlings were then transplanted and finally, when they got their first pair of leaves, they were planted in the open air, each plant in a separate pot. Before the opening of the buds, and after the flowers were pollinated, the flower stalks were carefully covered with heavy white muslin to protect them from the larger flying insects. They remained in this isolation as long as the capsules were ripening. In order to protect the isolated flowers against the invasion of the smaller creeping insects, the stalks were covered with cotton at the place where the bottom part of the muslin hood was tied down. The castration of very

*Delivered at the meeting of "The Journal Club" at "The Station for Experimental Evolution" in Cold Spring Harbor, N. Y., U. S. A., held on March 5, 1925.

EXPERIMENTAL CULTURE OF MIMULUS

Figure 1

View of the experimental garden at "Slupi" of the Plant Physiological Institute, Charles University, Prague, Czechoslovakia. Space is available here for about one thousand plants with additional facilities in other parts of the Institute.

young buds before the opening of their anthers, was a simple matter, as the filaments were taken out through a hole made on both sides of the flower-tube by a small, sharp knife. The artificial pollination of the stigmas at the time of pollinating was performed with a clean splinter of wood, freshly prepared for each new operation.

Even for recording data regarding the flower spots we have adopted a very simple method. The petals are cut off and spread with their upper surface on a clean glass. Then they are covered with a small piece of blotting paper and another glass plate. After the flowers are dry they stick to the first glass, and can be copied on "Bromaryt" Photopaper in the same way as it is usual with negatives. Our collection of such prints now numbers between 60,000 and 70,000, a unique collection for biometrical studies. Finally very accurate descriptions of each cultivated plant, and of all experiments, were carefully put down into a breeding book, which contains now about 4,000 pages (not yet published).

Inheritance of the "Rubinus" and "Speciosus" Characters

In the *rubinus* variety the petal spots are spread over the whole surface of each petal, while in the *speciosus* variety they cover only one half of it. The spots of both kinds could be very well seen from both sides of the petals and characterize entirely both varieties of this well marked garden species, *quinquevulnerus*. In 1912 we got from a *quinquevulnerus-rubinus* hybrid, which was taken out of a *rubinus* population after the autogamy of its single blossom, a progeny of 107 individuals, among which two distinct phenotypes, *rubinus* and *speciosus*, without any intermediates, have appeared. Both these types showed frequencies in accordance

with a simple Mendelian case, so that on the average three *rubinus* appeared to one *speciosus*. It was evident that this was a case of simple Mendelian inheritance in which the *rubinus* character was dominant, the *speciosus* being recessive.

In the following year (1913) in a progeny of the second hybrid generation of 1912 we found many pure *rubinus* lines (See Figure 2a), as well as pure *speciosus* (See Figure 2b), which have been kept by constant autogamy to the present day. In 1917 we got from both these lines, lines with a dark yellow ground color of their petals, combined with a reddish brown color of the spots, and lines with pale yellow or nearly white ground color with magenta spots, respectively. While the yellow color is caused by different carotins, bound to small plastids, the red color is caused by anthocyans, dissolved in the cell sap. In 1914 we found in each of these pure lines a single plant with variegated or white striped foliage, as a very rare mutation, the heredity of which was afterwards proved to be entirely non-Mendelian, although the character is definitely inherited.

In 1914 and 1915 we crossed reciprocally the *rubinus* lines with *speciosus* lines, and got an artificial hybrid *rubinus* with an entire dominance of the *rubinus* character. (See Figure 2c). The reciprocal crossings between such a *rubinus* hybrid and a pure *rubinus* or pure *speciosus* plant produced a progeny consisting of *rubinus* types only, or one made up of half *speciosus* and half *rubinus* types, respectively. These experiments were performed in 1915 and 1917. It was then proved that the dominant *rubinus* character is transmitted as an inherited character, which is caused by only one hypothetical factor, that probably causes the spot of the *speciosus* type to spread over the whole surface of the petal. The inheritance of the *rubinus* and *speciosus* character was proved by a great number of experiments and in many individuals; for example, there were 1660 plants in the second hybrid generation observed in the period 1914-1917.[5]

Inheritance of the "Tigrinus" Spots

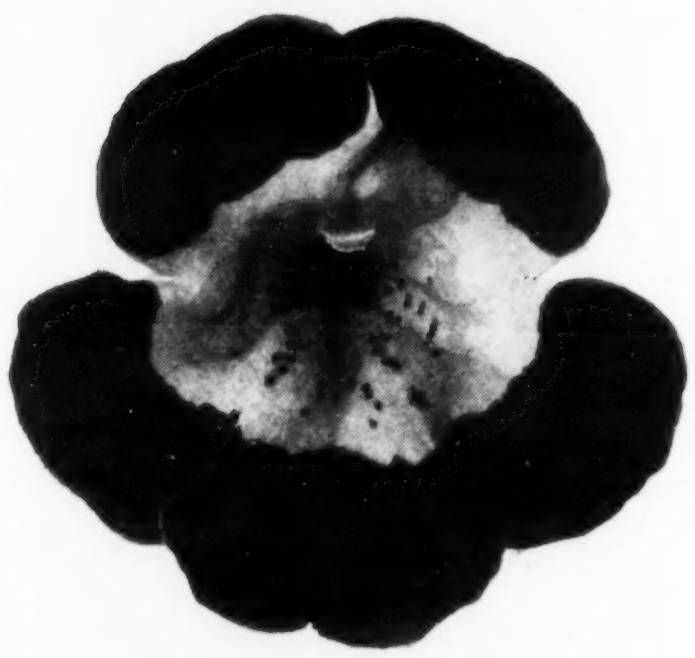
This character is again a character of the petal spots, and could be very well observed in the flowers of the differently spotted types of pure *tigrinus-variegatus* lines and of the hybrids between those lines and the *tigrinus-luteus* lines, the blossoms of which are without any spots. The *tigrinus* character is especially well marked by the fact that the spots are scalloped on their edges and often divided into smaller round dots. They are further distributed over the petals according to the bilateral symmetry of the blossoms, and appear on both surfaces of the petals. The inheritance of this character was for the first time proved by crossing the *tigrinus-luteus* line with *tigrinus-variegatus,* both varieties of the same *tigrinus* species, derived by selfing the single slightly spotted blossom of a plant which was probably a hybrid. The progeny consisted of a great number of different types, as far as petal spots were concerned. These varied from plants with entirely yellow blossoms without any spots, to plants whose blossoms had spots developed to their utmost extent. There was no doubt that the original mother plant, taken out of a garden population, was a hybrid, which after autogamy of its blossom gave a great number of differently spotted types.

There occurred in this progeny many intermediate types between the two extremes mentioned above. These intermediates were the most numerous class, the solid yellow (*variegatus-luteus*) and the most heavily spotted *variegatus-tigrinus*) were the rarest types. Both of these lines (see Figures 2d and 2e) date from 1913 and both have been maintained by constant selfing to the present day. On the other hand, the *luteus* lines from 1915 and 1916 at first produced some individuals, in which at least some of the flowers had a small red spot on the lower odd petal. After repeated se-

A—Rubinus

D—Luteus

C=F_1



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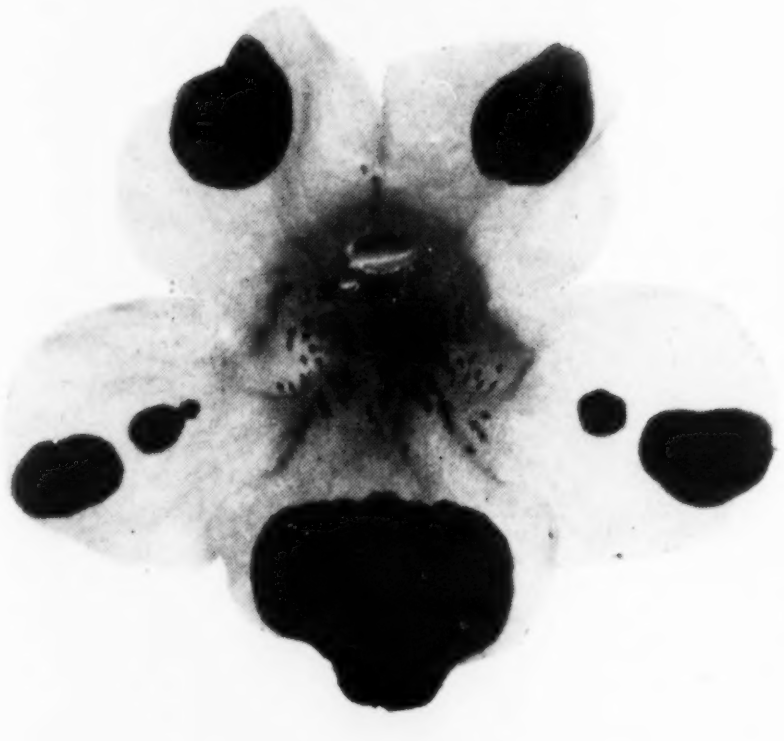
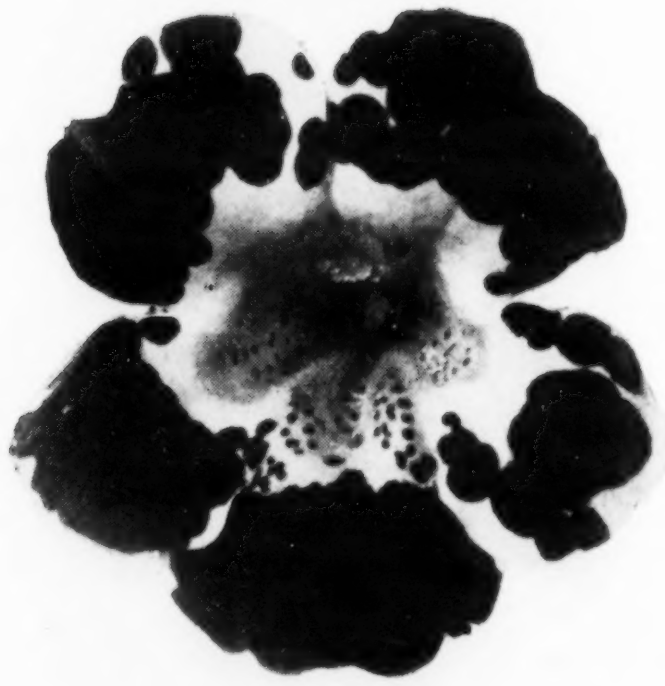




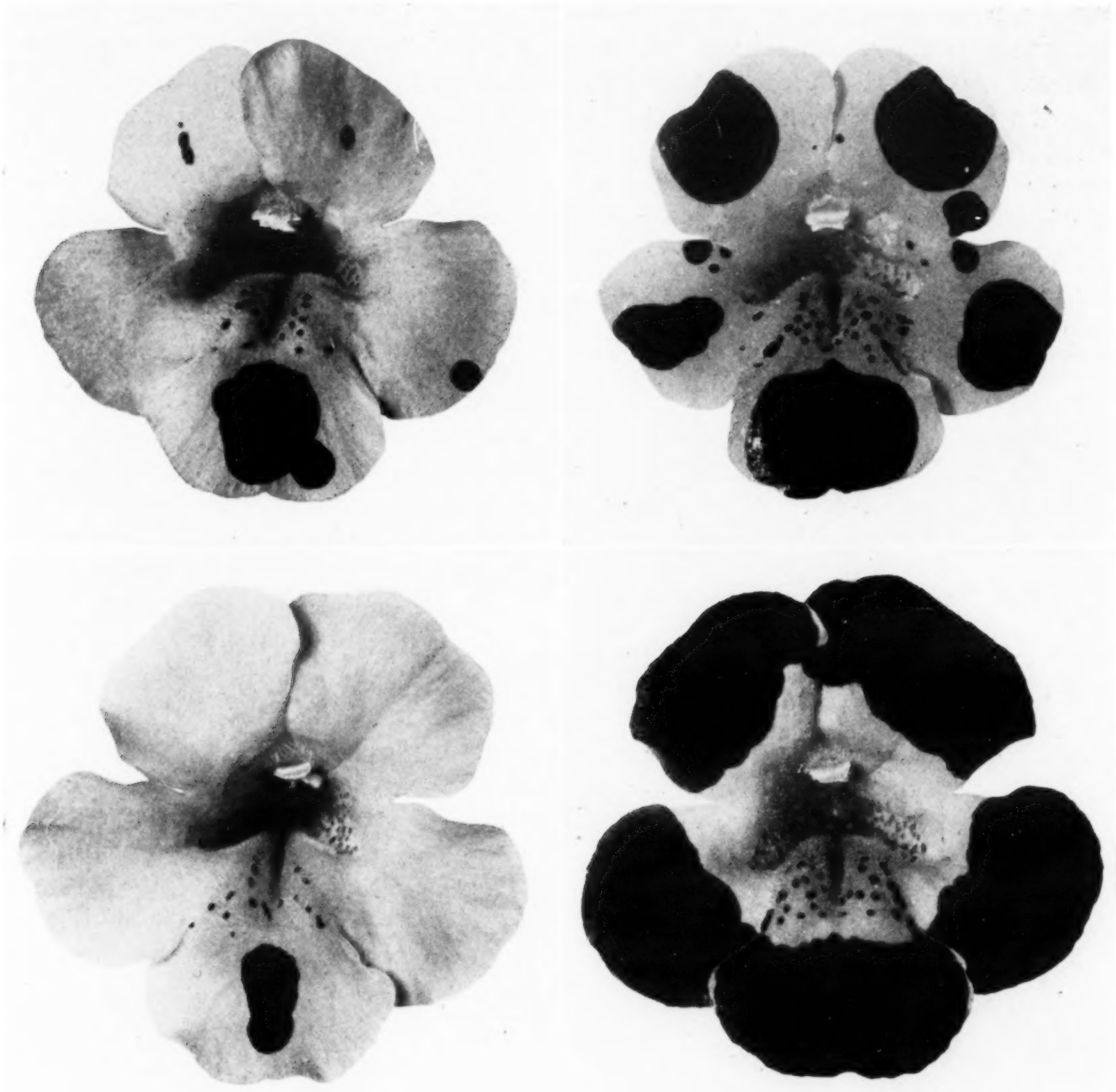
B—Speciosus

E—Variegatus

FLOWERS OF PURE RACES AND OF HYBRIDS

Figure 2

The flowers of pure races of *Rubinus* and of *Speciosus* are shown at the left with the flower of the first generation hybrid in the center. The *Rubinus* pattern is dominant. The progeny of the hybrid segregates in a ratio of three *Rubinus* plants to one *Speciosus*. *Luteus* and *Variegatus* are varieties of *Mimulus tigrinus*. When these are crossed the first generation hybrid (right center) is intermediate between the parental types. The inheritance of the *Variegatus* spotting is complex, and two or more factors are probably involved.



HYBRID FLOWER TYPES

Figure 3

In the hybrids of *Variegatus* with *Rubinus* and *Speciosus* the flowers greatly resemble those of the pure races of the two latter varieties. The difference between the two types appears in the next generation, when many flower patterns are found in the hybrid progenies.

lection in the following years this was finally eliminated. Both lines, the *luteus* and *variegatus*, gave by continued selfing in the next years a number of different lines which varied in the shade of the yellow ground color of their blossoms and in fertility, or better to say, in the production of pollen. Some lines were grown with almost white blossoms, others with pale yellow and others again with dark yellow ones. The decrease in the fertility began especially in the pale yellow lines, in some of them even in the second or third generations, whereas in the others this has not as yet been observed. In other lines it appeared at different times in later generations. This decrease of fertility and vital capacity appeared in different lines, especially in the *quiquevulnerus* lines, both in *rubinus* and in *speciosus*.

As soon as lines of *luteus* and *variegatus* were genetically fixed, reciprocal crossings were made in 1913 and 1914. The result of these crossings was an artificial *luteus-variegatus* hybrid (See Figure 2f) with blossoms, which re-

sembled the blossoms of the less spotted intermediate types of the progeny of the original mother plant in these experiments. It was evident that the inheritance of the *tigrinus* character is intermediate, and probably caused by a number of (probably not by many) cumulative factors, the number of which has not yet been determined experimentally.[9]

Hybrids Between Different Garden Species

a. Luteus-Rubinus Hybrids.

In 1915 and later, the result of crosses between *luteus* and *rubinus* lines was a hybrid (See Figure 3a), the flowers of which had spots, developed to an intermediate extent and distributed on the petals according to the bilateral symmetry of the whole blossom. It was found that these spots were to a certain degree variable, even in the flowers of the same plant. It was further found that the variability of this intermediate hybrid character increased in the individuals of the next, i. e., in the "second" hybrid generation, reared from these hybrids by self fertilization in 1916. There were found among the individuals of the second hybrid generation some plants which had *quite yellow* flowers, as well as flowers which fully resembled those of the *rubinus* parental plant.

With the aid of many progenies it was found in 1917 that out of 112 plants of the second hybrid generation eighteen or nineteen per cent were homozygous for different grades of spots. This statement was the general reason for the supposition that this intermediate variability might be genetically caused by two or three pairs of cumulative factors. The reciprocal crossings between such an intermediate hybrid *luteus-rubinus* and the *luteus* or *rubinus* parent gave progenies, the variability of which was again intermediate, but on an average between *luteus*-like or *rubinus*-like types respectively. This genetical analysis of the great individual variabilty was most difficult and tedious. While it was in progress more than 3690 photographs of different flowers were examined and compared.[7]

b. Luteus and Speciosus Hybrids

A similar situation has been observed in reciprocal crossings of the pure *luteus* race with *speciosus*. The *luteus-speciosus* hybrids (See Figure 3b) also showed spots of intermediate size on their petals, but in comparison with those of the *luteus-rubinus* hybrid only of half the size. The majority of plants of this hybrid had flowers with only one spot on the lower odd petal, about half the size of the spots of the *luteus-rubinus* hybrid. Entirely yellow flowers and flowers with the *speciosus* pattern were never seen, even though the intermediate patterns were most variable. In the selfed progeny of these hybrids, on the contrary, both of the parental types reappeared, although they were much less numerous than the intermediates. Nevertheless, the number of cumulative factors for this intermediate inheritance has not as yet been determined. On the other hand, reciprocal crosses between the *luteus* or *speciosus* type with the later *luteus-speciosus* hybrid gave progenies in 1916-1917, which showed unsymmetrical variability, the majority of plants being *luteus*-like or *speciosus*- and *luteus-speciosus*-like types respectively. The *rubinus*-like types did not occur, while no *rubinus* parent had been used for the original crossing.[8]

Hybrids of Variegatus, Speciosus and Rubinus

Very fine and interesting results were further obtained through reciprocal crosses of *variegatus* and *speciosus* and of *variegatus* and *rubinus*. Both these experiments were performed in 1915 and 1916. It is evident from the blossoms that the reciprocal *speciosus-variegatus* hybrid greatly resembles a pure *speciosus* type, but with large round spots. (See Figure 3c.) On the other hand the *variegatus-rubinus* hy-

brid (Figure 3d) had the most striking resemblance to a pure *rubinus,* or perhaps to a *rubinus-speciosus* hybrid. It was evident that phenotypically it was very difficult to tell the two above mentioned hybrids from other types they resembled, though they could easily be distinguished by a comparison of their progenies. It may be stated as a rule that in the second hybrid generation we may expect the reappearance not only of both the original parental forms, with the lowest frequencies, but also a greater number of different intermediate types than was the case in the first hybrid generation."

A Double Blossomed Type and an Artificial Mosaic=Hybrid

I desire especially to call attention to the origin of a "double" flowered variety of the *tigrinoides*-species. This type was found, but with its characters only very slightly developed, in a hybrid generation in 1914, which had been grown by selfing a single blossom of the third original mother plant, taken from a garden population. (A similar form with double flowers was received by Benary at Erfurt, Europe, about the year 1867, and was called by him *Mimulus tigrinus,* var. *duplicis.* It was reared probably under similar[4] circumstances as was the case with the type in our experiments.) The blossoms of this original mother plant greatly resembled the blossoms of our artificial mosaic hybrid made by crossing later on (the *Paulina* hybrid). In 1914 there were found in one generation among twenty-four individuals twenty-one that were plain, and three with slightly double blossoms. In this generation the variability of the petal spots was very great, showing all the types, which were afterwards found in the flowers of the above mentioned artificial mosaic-hybrid *Paulina* or perhaps in the members of its progeny.

The three slightly double blossomed plants showed some few, narrow excrescences between their filaments, growing out of the inner surface of the flower-tube. These excrescences were not longer than the filaments and greatly resembled petaloid filaments, being turned with their inner surface to the inner surface of the tube and covered with many small, red, round dots, just as was the case with the inner surface of the tube. Later on they were recognized as a paracorolla, especially, when they were observed on the pure race in their fullest development. They could be explained from the morphological point of view[21] as doubled or split broader parts of leaves, while from a phylogenetical view perhaps as an old character which had reappeared as a result of the cross (See Figure 4). They never had anthers and their greatest number was ten. By strict autogamy and selection for various degrees of double blossoms, I was able in many successive generations to isolate a number of pure lines differing in the degree of the development of the paracorolla. Finally, since the year 1917 I have been able to cultivate a great number of such lines, in which this peculiar character was developed to its highest degree. Before that time the different double flowered lines had some flowers on every plant still plain and all the lines showed even some plants with flowers without a paracorolla. I have obtained since 1917 many lines with entirely yellow flowers without spots and with very long peduncles of the flowers, and especially with the paracorolla developed to its highest degree. While the spots of the *triginus* species were regularly absent, except for a very small spot in the centre of the lower odd petal, there was a well marked circle of small adjoining dots at the upper end of the flower-tube, which could be seen best only on the inner surface of the blossom. This character was later found to be independently inherited and was one of the two components of the mosaic pattern of the flowers of the *Paulina* hybrid.

The above mentioned effect of selection on different double flowered lines has led us to the supposition that the paracorolla is an inherited character based on certain cumulative factors,

A DOUBLE-FLOWERED STRAIN

Figure 4

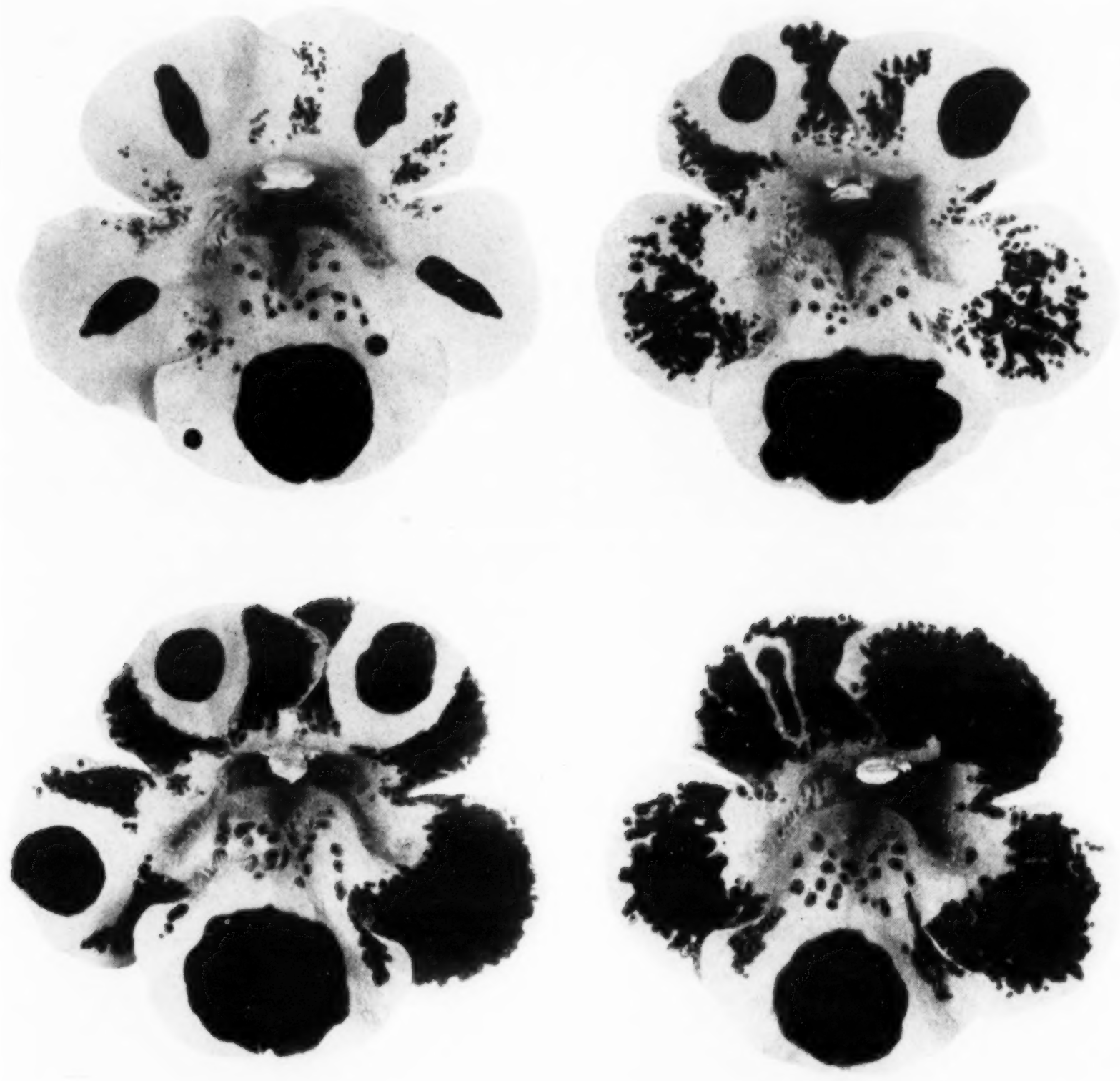
By selfing and selection a pure race was developed, which had a paracorolla as shown above. Genetic analysis indicates that the development of the paracorolla is inhibited by two factors present in the *Rubinus* strain.

possibly not a large group. Thus this race could hardly be maintained in the open air without human intervention, as its filaments were entirely hidden by the paracorolla, especially if the paracorolla was well developed. Therefore natural self pollination or crossing is entirely excluded, except in the slightly double flowered lines, where are also some plain blossoms.

In 1918 I began crossbreeding experiments with the most double flowered line in order to examine the genetical basis of this character. I crossed reciprocally this double flowered pure plant with the pure *rubinus*, a line which never had a paracorolla. The result of this cross was the *Paulina* hybrid, the blossoms of which had the typical mosaic composed of two distinct and different types of spots, and blossoms *without* paracorollas. There was a close resemblance in respect to the mosaic patterns of this hybrid and the original mother plant, out of which the double blossomed lines were obtained. And now it could easily be stated that this mosaic was really composed of two different components: one of them the spot of the *rubinus* parent, but intermediate in size and visible from both surfaces of the petal, and the other belonging to the *tigrinoides* race, composed of small fusing dots, which frequently surround the first *rubinus* component, spread almost only on the upper, inner surface of the petal. Both these components were separated from each other with a yellow stripe and were both very variable in their size and development. (See Figure 5).

The variability of this mosaic was so great and the blossoms of the same plant and frequently of the same pair of leaves were so different, that they looked like the blossoms belonging to two quite different individuals! We have described this *tigrinoides-rubinus* hybrid as a new hybrid variety *Paulina*, although it greatly resembled an old garden hybrid (*tigrinoides*), which had already been known since 1863 among Vilmorin's cultures in Paris. Vilmorin's description of this hybrid[1] indicates a similar great variability in the flower spots and the drawings show a mosaic of spots as is the case in our plant. Both these hybrids might perhaps prove to be identical.

The flowers of this *Paulina*-plant were entirely plain, they *never* had



"PAULINA" HYBRIDS

Figure 5

These are all hybrids between the double flowered type (Figure 4) and *Rubinus* (Figure 2*A*). The mosaic of spots is developed to varying degrees in different plants. Although the paracorolla is entirely supressed in the first generation hybrids, it appears again in the second, in ratio of 57 plain to 7 double.

a paracorolla. While the paracorolla was never found in the first hybrid generation, it appears again in the second, among the selfed progeny of the *Paulina* hybrid. The reappearance of the paracorolla (somewhat reduced in size) in the second hybrid generation, occurred according to Mendel's law, in such a way that it appeared again among sixty-four plants only in seven plants on an average. This ratio, 57 "single": 7 "double" could be explained by assuming the genetic factors (*A* and *B*), which were derived from the *rubinus* parent. Either or both of these factors would be assumed to suppress the factor *X* (and its allelomorph *x*, or perhaps a whole group of factors *(X, x)*, which is responsible for the development of the paracorolla. For these three factors the genetic constitution of the *Paulina* hybrid would be *(AaBbXx)*. This supposition has shown itself to be most probable by two sets of reciprocal back-crosses of the *rubinus* races(*AABBxx*) with "single" blossomed races of *tigrinoides* (*aabbXX*) and with "double" flowered Paulina hybrids. Though in the first experiment (*rubinus* × *tigrinoides*)

there were some progenies composed entirely of "single" flowered plants, there were, on the other hand, in the second set of experiments (Paulina × "double") two types of plants in the ratio 1 "double": 1 "single," or more precisely 32 "double": 32 single," but with a very slight excess of the "double" blossomed individuals. This excess could perhaps be explained by the unequal power of the *A*, *B*, and *X* elements.

The biological significance of this case is very interesting. Though the paracorolla is a most "inconvenient" character, resembling in its biological significance the "lethal" factors, nevertheless it reappears regularly. Thus it might be preserved in a latent state: even by autogamy! The double-flowered plants, having wide outstanding stigmas, could easily be cross fertilized, but by the single types only, and bear in their germ plasma the above mentioned two hypothetical suppressing factors and give in their progeny only plain plants. These single-flowered hybrids could again be fertilized without difficulty in the open air, especially by the larger insects. These circumstances finally bring, by the mechanical recombination of Mendelian factors the reappearance in nature of this very fine, but it might perhaps be said "unusual and wrongly-built" type.[8,9]

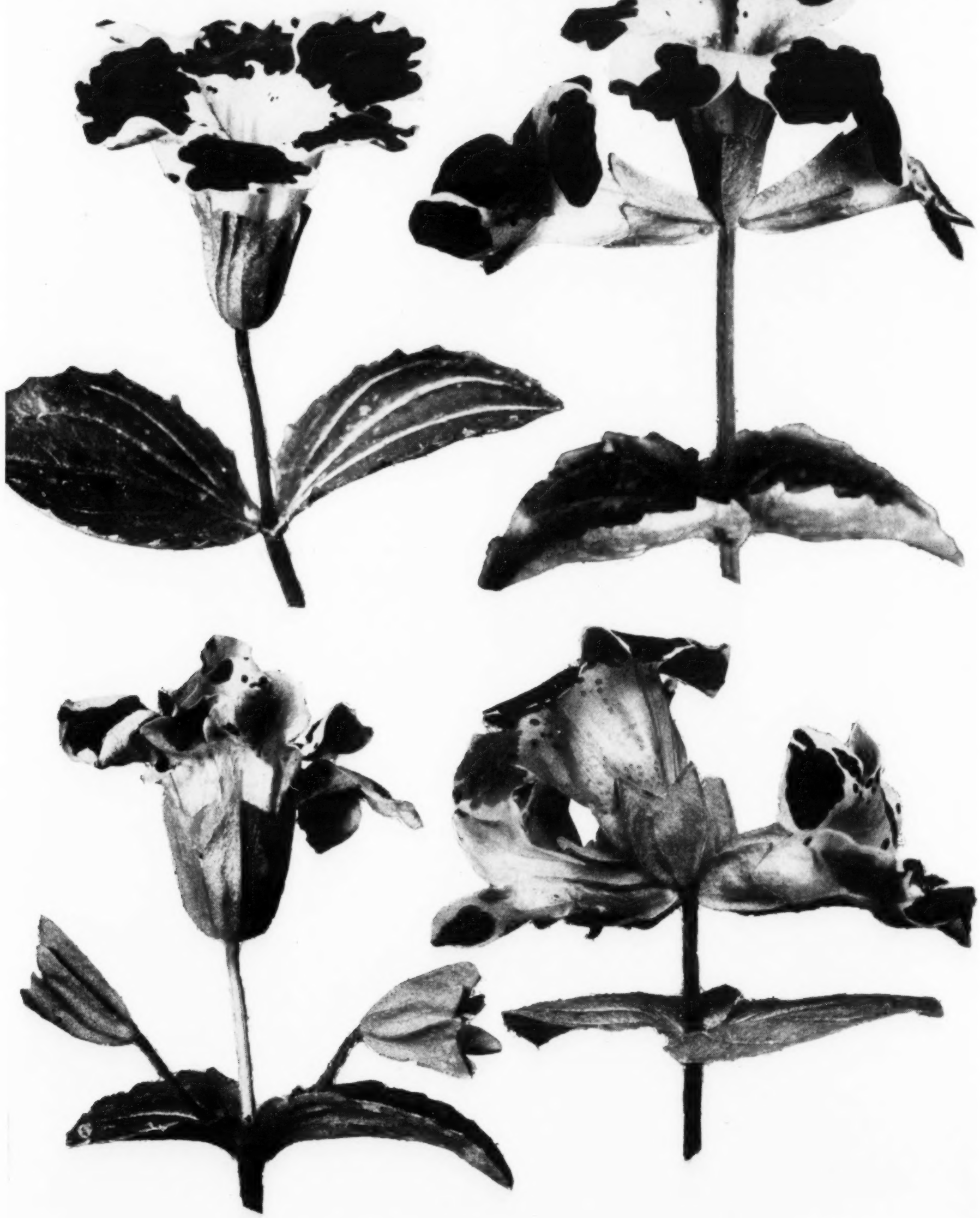
A Peloric Tigrinus-Variegatus Hybrid

Peloric flowers are very common in many different forms of plants, especially among the Scrophulariaceae. They have been described and genetically treated in *Antirrhinum* by Bauer,[11] in *Linaria vulgaris*, by de Vries,[12] and in *Digitalis purpurea* by Warren.[13] It is interesting that the pelory in *Mimulus* plants could be genetically analyzed in our cases and that its reappearance in the *variegatus-tigrinus* lines without pelories was a periodical phenomenon. I first found some individuals with pelories among many individuals in one pure line of the *variegatus* variety in 1914, and subsequently in other *variegatus* lines. While attempting to isolate this peculiarity and to fix it genetically in a pure line, we selfed one plant with peloric flowers which had been selected from many plants of a *variegatus* line without them. In this progeny, the number of individuals with pelories was only slightly increased.

By further selection of plants with pelories, I was able to rear many selfed lines from them in 1915-1917, in which the number of plants with pelories was greater or smaller, until in 1917 I selected one plant with well developed pelories the progeny of which was composed of individuals with pelories only; not even one plant was without them. (See Figures 6a-c.) And by selfing this peloric line I obtained in the following generations a wide range of peloric lines from many different individuals, which have been reared since that time until the present day.

The pelory in our cases was combined with many other physiological and morphological characters. First the peloric flowers occurred at the ends of the main and the lateral axes, and were combined with normal, zygomorphic blossoms on the same plant. The pelory regularly checked the growth of the main and the lateral axes, and therefore the plants were procumbent and bushy, with many lateral branches in the lower parts, especially in the pure lines with pelories. The growing together of the pelory and of the nearest two normal lateral blossoms, so called "synanthium," was very common. Many different, more or less condensed types of synanthias (See Figures 6b-d) were noted and cases were found in which the whole group of the middle pelory and the two lateral zygomorphic blossoms resembled the blossoms with many petals, sepals and anthers, but with only three pistils, the middle one normal, while the two lateral ones were degenerate. The corollas and calyces of such "condensed" pelories were often longitudinally split in one or more places. They were plain or filled with excrescences, which

A



C

B

D

DEVELOPMENT OF PELORIC FLOWERS

Figure 6

Showing a single peloric flower (*A*), and peloric flower combined with normal lateral blossoms, but more or less condensed (*B, D*). In crosses with *Rubinus* the peloric condition is dominant (*C*) to the normal and in the second generation 3:1 segregation occurs.

A

B

PROCUMBENT GROWTH AND ABNORMAL COTYLEDONS

Figure 7

This type of procumbent plants was characteristic of certain *Tigrinus* lines. The inheritance of the character was not studied.

Certain lines of *Quinquevulnerus* were characterized by having some of the plants with cotyledons grown together.

A B

SERIAL FLOWERS AND DWARFS
Figure 8

Serial flowered lines were found in *Tigrinus,* while other strains were characterized by dwarf habit of growth and very early blossoming, (8*B*).

greatly resembled that of the above described paracorolla, but originated most probably from parts of split corolla and calyx, especially in cases where the nearest leaves to the peloric group of flowers were developed like a calyx, and the true calyx developed like a calycanthema.

We have found for this peloric form the most simple rule of Mendelian inheritance. By reciprocal crossings between pure *tigrinus* lines having pelories with *rubinus* lines without them, I have found that the hybrids of the first generation were *all* peloric, having different degrees of more or less condensed types of the pelorical group of flowers. (See Figure 6c.) The peloric condition as a whole appeared as a quite dominant character. The second hybrid generation of these peloric hybrids was on an average always composed of three peloric individuals and one normal. The pelory combined with normal flowers on the same plant was then proved experimentally as a simple Mendelian character. By reciprocal crossings of such hybrids with pelories, i. e. *tigrinus-rubinus* hybrids with pelories, with the *rubinus* parental line without pelories or with the *variegatus* line with the pelories, I got progenies, which were composed of one half the plants with them, and the other half without pelories, or progenies composed only of plants with pelories, respectively.[6]

Various Other Inherited Characters in Mimulus

While I found all the above described characters as inherited according to the more or less complicated Mendelian rules, I have, on the other hand, found many other characters, which were all proved to be inherited, but without knowing the rules of their inheritance. I found among them, for instance, in some *quinquevulnerus* lines the cotyledons abnormally grown together (See Figure 7a), in others again (*tigrinus* lines) "serial" flowers, practically two flowers on the same stalk (See Figure 8a), in other *tigrinus* lines again a procumbent and compact growth (See Figure 7b), and finally in certain *variegatus* lines,

A B C

VARIEGATED LEAVES, A NON-MENDELIAN CHARACTER

Figure 9

The plants in the center and at the left are from pure variegated lines of *Quinquevulnerus-Speciosus,* the right-hand plant is a hybrid (i e. *Speciosus,* variegated × *Luteus,* green), being the result of crossing a Variegated mother plant with the pollen from a normal green plant. It was found that the degree of variegation in the progeny is determined entirely by the variegation of the calyx and the carpels of the flower used as the pistillate parent. A flower with a green calyx and carpels always produces green progeny regardless of the pollen plant. Flowers with variegated calyces always produce variegated progeny, and the extent of variegation is also inherited, but in a complex and entirely non-Mendelian fashion. The variegation is determined by the plastids rather than by the chromosomes. The greater number of plastids in the egg plasma have a predominating effect.

dwarfism with early blossoming (See Figure 8b).[6]

Variegated Leaves a Non-Mendelian Character

"Variegated" leaves, or leaves with white stripes were found in 1914 in *rubinus* and *speciosus* lines, among a very great number of individuals of the same progeny, reared out of entirely green ancestors as a rare mutation. The single variegated plant among 113 others was found in a selfed *rubinus* line, from a flower of a normal plant and a plant with normal, green ancestors. The single variegated *speciosus* individual was found under the same circumstances, in a progeny of 143 plants. The *rubinus* plant was so slightly variegated that all its blossoms, which were selfed, had only green calyces. In the two succeeding selfed generations all the lines were composed of entirely green members. The variegation never reappeared among them.

On the other hand, a *speciosus* individual was found in 1914 which was much more variegated. On the entirely green parts of the plant the flowers had entirely green calyces and carpels, while on the variegated parts the buds had sepals and carpels entirely white or variegated in different degrees. According to these circumstances and without any regard to the other remaining parts of the whole plant, I was able to get two quite different pure lines out of the original variegated *speciosus* mother-plant: the "B-lines," derived by selfing flowers with green calyces and composed only of green members, and the "A-lines," derived also by selfing, but from flowers with variegated calyces and composed of green and variegated individuals (See Figures 9a, b).

The white striped individuals were true "chimeras," being composed of two quite distinct types of tissues: green tissue with normal cells and green, normal plastids, and entirely white tissue, composed of abnormal cells, with undeveloped plastids, very few in number, poor and white. The green and the white tissues were irregularly distributed throughout all parts of the subepidermal tissues, but not in the epidermis. The palisade cells and the upper and lower parenchyma layers could be composed of entirely green or entirely white groups of cells. This true "mosaic" of green and white, without any intermediate tissues or cells began to show itself during the germination period and was visible on both of the two cotyledons of the young seedlings. This fine mosaic could have further been noticed not only in the leaves (See Figure 9a), but also on the petioles, on the blossom-stalks, on the internodes of the stem, and on the sepals and carpels. It was sometimes found that this fine "mosaic" changed into a distribution of tissue typical of the so-called "sectorial chimeras" (See Figure 9b). The "periclinal chimera" (according to Baur's terminology) does not seem to have occurred in our plants.

Although the origin of the entirely green B-lines and the origin of the more or less "variegated" A-lines has confirmed the main rule, they have been followed until the present day in order to get lines showing different degrees of variegation, nevertheless this rule has been followed in the selection of buds with moderately variegated calyces to secure some variegated members in the progeny, while the selection of buds with entirely white calyces (and probably with white carpels) has led to a progeny composed of all or nearly all plants entirely "white," which were not able to live. It was also found that the number of the variegated individuals among a progeny from one blossom corresponded to the grade of the variegation of the calyces and perhaps of the carpels; and this rule was found to be true not only in the homozygous plants, but also in *every hybrid*.

After formulating this rule we were able to rear at will progenies either entirely white, which died soon after

have a predominating effect.
also inherited, but in a complex and entirely non-Mendelian fashion.
chromosomes. The greater number of plastids in the egg plasma

germination, or variegated in different degrees, or perhaps entirely "green," even from a variegated mother plant! The same rule was found to hold in crossing and selfing hybrid flowers. The first variegated *speciosus-luteus* hybrid was made in 1916 by crossing a "variegated flower" of the *speciosus* mother plant with a normal green *luteus* type (See Figure 9c). This plant was not the only variegated one in this progeny. There were among the many green hybrids some with more or less variegation of their leaves. On the other hand the reciprocal experiments, made in 1918 led us to an entirely green hybrid progeny. In that experiment all the hybrids were green, because the mother *luteus* plant (including the calyces) was entirely green, although the pollen was taken from a variegated *speciosus* plant, and from a blossom with a nearly white calyx. In these reciprocal experiments the progeny again resembled the "green" mother. By these and many similar experiments we demonstrated that the variegation was inherited only "after the mother plant" and that not only the variegation itself, but also the number of variegated plants in the progeny always depended on the degree of variegation of the calyces, but not on that of the entire plant. It was evident that the inheritance of the variegation of leaves in our cases was a non-Mendelian phenomenon, while the number of variegated plants in the progeny did not follow the Mendelian ratios, which are results of combination processes of genes, carried in different chromosomes.

The inheritance of variegation in our cases, especially in crossing, exclusively "after the mother," could very well be explained by the fact that *the plastids alone could be held as a carriers of genes* responsible for this case of non-Mendelian inheritance, especially, because it has been experimentally as well as morphologically proved by Sapehin,[14] Borovikov[15] and Nemec,[16] and further supported by cytological observations of Brown,[17,18] Fergusson[19] and Renner[20] that in their origin the plastids are bodies quite independent of the plasma, as well as of the nucleus itself. Most probably the greater number of plastids in the plasma of the ovules, formed from the cells of the white tissue of the carpels, or, on the other hand, a lower number of normal green plastids, which could be brought into the egg-plasma, and the very small number of the white ones from the paternal side, could be taken as a good explanation of the inheritance of the variegation in this case. Not only the white tissues, but also the number of abnormal plastids, being in every case greater in maternal egg-plasma, than in paternal pollen-tube plasma, might be held as responsible for this character in our plants.

Finally the non-Mendelian inheritance of the variegation of leaves is further confirmed by the fact that it was here independently combined with the true Mendelian inheritance of other characters. Such a case was observed in an experiment in which a *speciosus* plant was reciprocally crossed with a normal green *rubinus* plant, and where, while the *speciosus* plant was variegated and was considered a father plant, both in first and second hybrid generations no variegated plants were obtained, though the heredity of the flower spots has followed the simple Mendelian rule with the dominance of the *rubinus* character, as described above. Though these experiments tell us nothing about the *origin* of the variegation or about the possible influences, which might be held responsible for its origin, we are sure about the other two non-Mendelian rules of its inheritance, of which the plastids could be held as the most probable mechanical basis.[10]

Literature Cited

1. Vilmorin-Andrieux et Cie.: Les Fleurs de Pleine Terre. I. Partie. Paris. 1894.
2. Bentham, G.-J. D. Hooker: Genera Plantarum. London. 1873-1876.
3. Gray, A.: Synoptical Flora of North America. Vol. II, Part I. New York. 1878.
4. Grant, A. L.: A Monograph of the Genus Mimulus, *Annals of the Missouri Botanical Garden.* Vol. II, No. 2-3. 1924.
5. Brozek, A.: A Simple Mendelian Case of Inheritance in *Mimulus quinquevulnerus.* (Jednoduchy pripad mendelovskeho dedeni v kresbe kvetu dvou ras Mimulus quinquevulnerus Hort.) *Biologicke Listy.* 1921. Vol. VIII. Prague.
6. Brozek, A.: The Main Results of the Breeding Experiments with *Mimulus,* fam. Scrophulariaceae. (Prehled hlavnich vysledku pestitelskych na rostline Mimulus, fam. Scrophulariaceae.) *Prirodni Veda.* Vol. III. Prague. 1923.
7. Brozek, A.: The Polymeric Inheritance of the Flower-Spots of the Hybrids between *Mimulus tigrinus-luteus* Crossed with *Mimulus quinquevulnerus-rubinus.* (Polymericke dedeni skvrn kvetu reciproknich misencu Mimulus tigrinus-luteus a Mimulus quinquevulnerus- rubinus.) Preslia. *Journal of the Czechoslovak Botanical Society.* Vol. II. Prague. 1922.
8. Brozek, A.: A New Mosaic Hybrid *Mimulus tigrinoides* Hort., Hybrid Variety Paulina. (Mosaikovy misenec Mimulus tigrinoides Hort., hybrida var. Paulina var. nova.) *Biologicke Listy.* Vol. VII. Prague. 1920.
9. Brozek, A.: A Report of the Biology and the Genetics of the Full Blossomed Plants. (Prispevek ku biologii a genetice plnokvetych rostlin.) Studia Mendeliana. Brno. 1923.
10. Brozek, A.: Selektions-und Kreuzungs-Experimente mit albomakulaten (weissbunten) Mimulus-Rassen. *Studies from the Plant Physiological Laboratory of Charles University,* Prague. Vol. I. 1923.
11. Bauer, E.: Einführung in die Experimentelle Vererbungslehre. Berlin. 1922. 5. und 6. Aufl.
12. de Vries, H.: Die Mutationstheorie. Vol. I. Leipzig. 1901.
13. Warren, E.: Inheritance in the Foxglove, and the Result of Selective Breeding. *Biometrika.* Vol. XIV. Parts I. and II. 1922.
14. Sapehin, A. A.: Untersuchungen über die Individualität der Plastide. *Archiv f. Zellforschung.* Bd. XIII. pp. 319-398. Leipzig. 1915.
15. Nemec, B.: Zurodneni u krivatce. *Verhandlungen d. böhm. Akad.* II. Klasse. Jahrg. XXI. No. 25. 1912. pp. 1-20. Prague.
16. Nemec B.: Das Problem der Befruchtungsvorgänge. Berlin. 1910.
17. Brown, W. H.: The Nature of the Embryo Sac of Peperomia. *Botanical Gazette.* Vol. 46. 1908. Pp. 445-458.
18. Brown, W. H.: The Exchange of Material between Nucleus and Cytoplasm in *Peperomia sintenisii. Botanical Gazette.* Vol. 49. 1910. Pp. 189-194.
19. Fergusson, M. C.: Included Cytoplasm in Fertilization. *Botanical Gazette.* Vol. 56. 1913. Pp. 501-502.
20. Renner, O.: Eiplasma und Pollenschlauchplasma als Vererbungsträger bei den Oenotheren. *Zeitschr. f. ind. Abst. u. Vererb.* Bd. XXVII. Pp. 235-236. 1922.
21. Vilhelm, J.: La Paracorolle des Fleurs de Mimulus. *Bull. Internat. de l'Académie de Science de Boheme.* 1922. Vol. XIX.

The Views of Welfare Workers

Proceedings of the National Conference of Social Work (52d session, 1925). Pp. 732, price $3, postage extra. Universityq of Chicago Press, 1925.

Most social work is of at least indirect importance to eugenics, and much of the discussion of this conference, such as that concerning mental hygiene, racial problems, and the family, is of direct significance. The volume under review gives a picture of what the most active workers in this field are thinking.

P. P.

A NEW GENETICS TEXT

A Review

THIS newest book on genetics from a British writer appears in a new series of Biological Monographs and Manuals, under the editorship of Dr. Crew and Dr. D. Ward Cutler of the Rothamsted Experiment Station. The aim of this series appears to be similar to that of the Monographs on Experimental Biology, issued by Lippincott under the editorship of Loeb, Morgan and Osterhout, namely, to provide a more extended account of recent work in some special field of biological investigation than is possible in either journal papers or ordinary text book treatment.

Dr. Crew's book partakes of the nature both of a text book and of a monograph. The first third of the book contains a condensed account of the usual subject matter of genetics—Mendelian theory, the cytological basis, and a rather extended exposition of linkage and the chromosome theory. About a hundred pages are devoted to sex-differentiation and the sex ratio, the special field of the author's own investigations, while the remaining chapters deal with inbreeding and outbreeding, the genetic aspects of fecundity, fertility and disease, and a discussion of such disputed beliefs as telegony and the inheritance of acquired characters. There is an extensive bibliography of some sixty pages.

The distinguishing features of the book arise from the author's attempts to approach and interpret some of the problems of genetics from a physiological viewpoint, and from a desire, which is apparently of secondary importance, to relate the results of experiments in genetics to the practical breeding of domestic animals. The former aspect does not become clear until the preliminary account of the methods and mechanism of heredity is out of the way, but in the treatment of sex there is a real attempt to harmonize the data from physiology and morphology with the facts developed under the chromosome hypothesis.

The discussion of sex, which forms the heart of the book, is introduced by a description of the chromosome mechanism of sex determination. The author accepts this mechanism as fundamental, but not final, for in an extended treatment of the physiology of sex differentiation, which follows directly, he presents many arguments for regarding a knowledge and interpretation of the developmental sequences intervening between the setting of the mechanism in the fertilized egg and the expression of adult characters as essential to an understanding of sex. The basis of the discussion is the modern theory, chiefly attributable to Goldschmidt, of sex as the expression of a physiological balance between opposing sex tendencies affected by variation in kinds and numbers of internal agencies influencing sex, but chiefly by the stage of differentiation during which they act. With various modifications this "time of action" theory is applied to the interpretation of normal sex differentiation, intersexuality, sex reversal and hermaphroditism in both vertebrates and invertebrates.

The applications to animal breeding are made more or less paranthetically throughout the book, by choosing illustrative examples from cattle, horses, sheep, swine, and poultry, by

*Animal Genetics, an Introduction to the Science of Animal Breeding, by F. A. E. Crew, Lecturer in Genetics in the University of Edinburgh and Director of the Animal Breeding Research Department. Oliver and Boyd, Edinburgh, 1925. Pp. XVII 420. 15 shillings.

interjected directions for the use of specific genetic facts in animal breeding, and by devoting considerable space, more than the subject warrants in this day (it would seem), to such breeders' beliefs as telegony.

The geneticist will notice a few errors in fact. The chief of these occurs in the diagram on page 102 where the female Drosophila heterozygous for two autosomal linked genes is represented as showing no crossing over and in the statement that following a cross of flies differing in two linked genes "no double recessive appears in F_2; this is regarded as trustworthy evidence of linkage." The doubly recessive class must appear in a sufficiently large F_2 if the genes are linked, otherwise one could only conclude that the different traits were due to one and the same gene. The sexual difference in crossing over, an important peculiarity of inheritance in Drosophila is not mentioned until several pages beyond this point, and the reader thus encounters some misconception at the beginning of the treatment of linkage in Drosophila. Many will question the author's definition of genotype as "a group of individuals all of which possess the same factorial constitution," p. 29. A greater precision of statement could be desired in several places. On page 263, for example, the statement that "crossing over either does not occur, or if it occurs, it does so to a much less extent in the heterogametic than in the homogametic sex" has some evidence to support it if it refers to crossing over of sex-linked genes. The factor for "white coat color" in mice, referred to on p. 130 as lethal is doubtless the dominant black-eyed white factor, and not albinism. The system of quadruple allelomorphs in mice on p. 145 should read, grey (agouti), light-bellied agouti, yellow, and non-agouti (black or brown).

It appeared to the reviewer that the chapter on the sex-ratio and the discussion of hormonic rejuvenation were handled less ably with respect to choice and critical evaluation of evidence than other parts of the book; nor was the review of evidence in either case made to lead to conclusions of general significance in genetics.

The book is addressed, in the preface, chiefly to animal breeders although it is obviously intended also for students of genetics and for working biologists. The breeder and the student are plainly told that they must learn the language of this new science if they would reap its modestly promised benefits, and the opportunity to learn is well offered in the early chapters. The book cannot be said to provide a "balanced ration" for such readers, however, because of the limitation of the subject matter almost wholly to animal material, and the considerable emphasis on sex at the expense of other genetic questions such as quantitative variation and selection. The biologist reader, however, who is apt to prefer the maintenance of a particular point of view, if well supported, to completeness or unity, will welcome the fuller discussion of the author's own field. All will gain from the book that the terms "genetics" and "Mendelism" are no longer synonymous, but that the frontiers of the science are expanding to include not only the simpler Mendelian conceptions which still form its foundation but also those relationships between heredity and development which assume greater importance with each passing year.

L. C. Dunn.

Botanical Criticisms

Dr. Crew's book deals primarily with animal genetics, but plants also figure in the discussion. For this reason a botanist's reaction to the book is of interest.—*Editor.*

In a few instances the author has failed to present his ideas on a particular subject in what seems to the reviewer to be a safe, clear and acceptable way. For example, on page 14 it is stated that "there may, or may

not, be equal numbers of ovules and pollen grains." On page 30, this rather startling sentence arrests the reader's attention, "the term 'breed' or 'strain' has no biological significance whatsoever." While the author's meaning in this statement is perhaps a little more clear when read in connection with other material in the same paragraph than when quoted as an isolated sentence, such a statement might easily be misleading to the very persons for whom the book is written.

In describing the well-known experiments of Nilsson-Ehle on inheritance of grain color in wheat (page 55) the author makes the curious statement that "the very palest of the individuals were looked upon as white, and the rest as reds of different shades of colour." There would seem to be no reason to shroud the non-pigmented class in such uncertain terms. Probably some careful students of size inheritance in plants would take exception to the statement on page 58, that "size in an animal is the expression of the interaction of a large number of factors, in a plant it results from the interaction of a relatively small number of factors." The reviewer knows of no sufficient evidence for thus distinguishing between animals and plants as regards the inheritance of quantitative characters.

The author makes a rather indefinite statement on page 96 when he says, "in the case of the Nilsson-Ehle experiments with wheat, all that is necessary is to assume that wheat has at least three pairs of chromosomes and that the genes R, S and T are resident upon separate ones." It would have been as easy to use the symbols R^1, R^2 and R^3 and to say that vulgare wheat, with which Nilsson-Ehle worked, has 21 pairs of chromosomes.

In discussing the species problem (page 153) the author makes this statement: "If a character is neither advantageons nor disadvantageous, the chance that it will become established in the race is extremely small." It may be noted that by whatever means evolution has proceeded in the past, a good many little "ear marks" or characters have become established, to which it is difficult, if not impossible to assign any importance in the economy of the individual or the species. As examples of such characters one may cite the apical tooth or beak on the empty glume of some wheat varieties, the bristles of the rachilla of certain barleys, the differences in awn types in oats, etc.

While there is much evidence which supports the author's statement (page 157) that "sex is the basis of evolutionary plasticity", the plant breeder will find it difficult to disregard the possible evolutionary significance of the not infrequent heritable bud variations, etc., which have been observed in Citrus, Coleus, Chrysanthemum and many other plants.

The critical plant geneticist will probably not find the author's statement (page 333) as to the meaning of the term xenia entirely satisfactory. "Xenia is the term used to define the phenomenon in which in the case of plants the pollen of the male parent seems to affect the tissue of the maternal ovary, the seed or even the fruit, as distinguished from the embryo itself." The term xenia is properly used to refer to the immediate visible effect of foreign pollen on endosperm characters, only.

It is surprising to find that a book which in general is so clearly written and well printed contains a number of passages in which obvious errors have crept in. While no doubt some of these errors are chargeable to the printer, yet in the last analysis the author and editors probably will have to shoulder the criticism which these are certain to engender.

J. H. Parker.

INSTABILITY IN PEACH VARIETIES

GEORGE P. WELDON

Chaffey Junior College, Ontario, Calif.

MUTANT BRANCH—POE STRAIN

Figure 10

This tree of the Ontario cling variety bears normal fruit, with the exception of one large branch shown on the left and marked with white cloth around the base. This bears fruit of an entirely different type (see Figure 11). Except for a slightly more vigorous growth this mutant branch cannot be distinguished from the rest of the tree.

IN A previous article* on this subject the writer emphasized the following points:

In the absence of positive knowledge regarding the origin of peach varieties it has generally been considered that they came from seed. Practically none are recorded as having originated as mutations.

It is certain that there are strains of the navel orange and other citrus varieties, and these latter have been definitely shown by the work of A. D. Shamel on bud selection.

Mutants are more common in peaches than anyone has recognized, and intensive orchard analysis of trees is needed to detect them.

The methods that have been used by nurserymen in cutting budwood from orchards without knowedge of individual trees, or from trees in the nursery that have never borne, should be condemned.

There was also described and illustrated in the article a peach mutant which was named Merrill. Nine trees of this interesting mutant which are now bearing good crops of fruit, show no variation from their type (which would indicate a chimera rather than a mutant), thus proving the stability of the strain.

*Journal of Heredity, 15:86-90, February, 1924.

NORMAL ONTARIO FRUIT AND MUTANT FORMS
Figure 11

The two peaches with foliage are from the tree shown in Figure 10, the one on the left from the branch which bears fruit of the so-called Poe strain, the other from the normal Ontario part of the tree. On the right are two fruits from a progeny tree of the Poe strain perpetuated by budding. These fruits are of very inferior quality and they are of practical interest only as indicating the danger or perpetuating such forms by careless selection of bud-wood.

At the present time there are apparently six mutants from peach and apricot trees included in the Chaffey Junior College collection. These have been discovered during only six years' investigation in a district containing about five thousand acres of peach and apricot orchards. Thus it would seem that there are unlimited possibilities for research and discovery in a field that has yielded practically nothing in the way of mutations.

In this article is described a second mutant of the six mentioned, which has been propagated and which has come true to the characteristics of the limb sport from which it came. It has been named "Poe," after the owner of the orchard where it originated.

Like the Merrill, this mutant appeared on a twelve-year-old tree of the Ontario variety of cling peach. The large branch shown in the illustration is the mutant part of the tree. In appearance it is almost identical to that of the other branches. Both leaves and twigs are typical of the Ontario variety, but the fruit is quite different. A little greater tendency toward vegetative growth has been noted, and perhaps a tendency toward lighter production. The branch contains ideal wood for propagation, and a nurseryman cutting budwood in the orchard where the tree is growing might pro-

pagate many hundreds of trees of a worthless variety, for the fruit has absolutely nothing to commend it.

The color of the fruit is like that of the Ontario, but the shape and quality are very different. The figure shows the extremely angular appearance of the fruit. Instead of a suture such as we normally find in fruits of the Ontario variety, there is a very sharp keel and the entire surface of the fruit is convoluted. The average size is somewhat smaller than the Ontario, the pit is large, and the flesh stringy and devoid of quality. This new strain is therefore of no commercial importance but will prove of great interest to the geneticist, particularly on account of its undoubted origin as a bud mutation.

Fruits from the typical parts of this tree and the Merrill have come true to the variety when budded. Propagations were made from these mutant branches in 1922 and from the normal Ontario part of each tree in 1923 and these progeny trees have produced fruits typical of their parents.

Our Biological Environment

BIOLOGY AND HUMAN WELFARE by JAMES EDWARD PEABODY and ARTHUR ELLSWORTH HUNT. Pp. ix, 584. MacMillan Company, New York, 1924.

The authors are to be congratulated on this excellent book, which links up man and the rest of the living world. They have succeeded in treating an interesting subject interestingly, which is not always the case with school texts. A very praiseworthy attempt has been made to make the book as accurate as possible by obtaining the cooperation of experts in all the fields covered.

Selection and improvement of plants and domestic animals is not discussed. A book on this subject certainly should mention such matters as breeding, genetics and Mendelism, all of which are quite ignored.

The discussion of Eugenics is confined to the last chapter, and does not seem to be altogether on a plane with the rest of the book. Habit formation is also dealt with in the same chapter, and one gets the impression that heredity does not matter much after all. It would be easy to infer from the text that the only really important matter is to attend school for the prescribed length of time. Of course, if this idea gets into circulation an increased interest in the question of Eugenics is not to be expected. Heredity and habits are so distinct that they should be treated separately, otherwise serious misunderstandings are likely to creep in, if only by inference.

The conception of the "Triangle of Life" (Heritage, environment and response) is hardly consistent: "But unless we make the best possible use of these two factors, heritage and environment, real success in life will never be ours. It is true that we are not responsible in any way for the heritage we have received. We have also relatively little responsibility, at least during childhood and youth, for the environment in which we live. Each one of us, however, unless he is below normal in mental ability, rightly is held to a strict responsibility for the third factor in the triangle of life; namely, the response we make to the other factors or, in other words, *what we do*. For example, one student in his high school course, even though his inheritance and his environment may not be of the best, wins success because he puts in his very best effort in training himself for life. For it is generally agreed that it is the successful effort put forth by the student that yields most in the educational process rather than the definite knowledge that may be acquired. On the other hand, another type of student fails in spite of

good heritage and good environment because he persistently neglects the opportunities that come to him."

It is not clear how our responses can be divorced from heredity and environment. Since, as pointed out, we are responsible for neither of these during the formative period, is it altogether fair or scientific to leave these factors out of account in considering behavior? One cannot but hope that some of the users of the text will cite Omar:

What! from his helpless creature be repaid
Pure gold for what he lent him dross-allay'd
Sue for a debt he never did contract,
And cannot answer—oh the sorry trade!

R. C.

A Handbook of Marriage

MODERN MARRIAGE, a Handbook, *by* PAUL POPENOE. The Macmillan Co., 1925. Price $2.50.

In the preface, the author notes the widely prevalent view that marriage is an institution which is no longer adapted to modern life and that essential changes are in prospect. He holds that this view is wholly in error and that the fundamental principle of a life-long monogamic marriage is at the present time, as in the past, scientifically unassailable. Most of the troubles with marriage today come, he believes, from a continued subordination of reason to instinct and custom in this matter, in a world where increasing complexity requires increasing reasonableness in all respects. The following difficulties are listed as particularly requiring consideration.

1. Young people are not properly educated for marriage. Many of them scarcely know what marriage means.
2. They do not always have the guidance to choose mates wisely.
3. They do not understand how to conserve and foster that mutual love which is universally admitted to be the essential element of a happy marriage.

The purpose of the book is to bring together data on these points. It is written primarily from the biologic viewpoint as that which the author considers most fundamental. Its presentation of "what a young man or young woman should know about marriage" is as frank and wholesome as a college course in biology and thoroughly human. It is an excellent handbook in practical eugenics. *S. W.*

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IDENTICAL TWINS WITH DEMENTIA PRAECOX

G. H. Parker
Zoölogical Laboratory, Harvard University

SINCE the appearance of Francis Galton's "Inquiries into Human Faculty" in 1883, a growing interest has been shown in the biological significance of twins. This has been expressed in numerous records of the structural, functional and mental similarities and dissimilarities of these pairs of human beings. A few years ago the Journal of Heredity issued a call for information about twins and subsequently devoted a whole number in Volume 10 to them.* It has since continued to collect material concerning twins.[14 21 26] That many twins are so much alike in appearance as to be indistinguishable under ordinary circumstances is well known. That they often act alike, think alike, and exhibit mental states of almost uncanny agreement has been claimed upon what is believed to be sound evidence. Probably because of the paucity of material very little attention has been paid to their diseases especially to their mental diseases. This lack of information was emphasized some six years ago by Frantz[6] who took occasion at the same time to give an account of a pair of twins suffering from dementia praecox. The pathology of twins has been recently reviewed and reported by Siemens,[25] and last year Murray[15] published a very interesting address in which he has discussed the general relation of twins to disease and has pointed out certain important biological aspects of this whole field. Frantz in his account of the pair of twins described by him dealt with the subject from the standpoint of nervous disease strictly and did not enter into a discussion of the biological problems involved. It is the object of this paper to touch upon these problems and to bring to the attention of students of this subject a second instance of twins suffering from dementia praecox.

Case I

The following brief summary will suffice to show the conditions of the two twins, J. S. and I. S., as reported by Frantz.[6] The abstract is taken from the original statement of the case.

J. S. was first seen in November, 1917, at the age of twenty. He complained of having been ill for a year, "not getting along steady," but in a "sort of sinking, lowering way;" "got out of the swim and couldn't get back;" "I always kept myself low." He couldn't explain what he meant by these phrases. He complained also of headaches, nervousness, and especially of inability to concentrate, to think, and feared he would become insane. He was constrained in manner, keeping his hand in front of his mouth while talking. During the following year he stayed at home almost unoccupied, spending much time sitting staring into space, sometimes with his fingers pressed against his ears or to his nose, occasionally laughing aloud without obvious cause, often refusing to eat or sit with the family; complained of inability to breathe, to think, to rest, to concentrate. His talk was loose and vague. "I have the worst thoughts come into my mind." In December, 1918, he began to get irritable, abusive in language, and even threatening toward his mother when she spoke to him, and on January 9, 1919, he was committed to Central Islip State Hospital. There, until February 24, 1919, he was dull, indifferent, made no spontaneous talk, did not associate with other patients,

*See Literature Citatations Nos. 4, 5, 27, 28, 29, page 143.

could not be induced to employ himself, showed no interest in the examination, but was approximately oriented and showed no particular impairment of memory. At first he was obstinate and resistive, assumed uncomfortable positions in bed, and refused to eat, but after a time ate of his own accord and was less resistive. His general health was good. His case was diagnosed as dementia praecox, catatonic type.

I. S.; the twin brother of J. S., spontaneously came to the clinic early in February, 1919, "because I get too excited." Alone with the examiner, he said he could influence anyone to do anything, with his mind, his stomach, his kidneys and other parts of his body; he had had this influence all his life, but didn't know it. He had a plan for a new Utopia. He said he didn't want friends because "I might influence them." "If anyone excites me, I get equally excited, and then I can influence them." He denied hallucinations. At a visit to the clinic February 18, 1919, he was reticent about his powers of influence and his plans for a new Utopia, but said he was working them out. He complained of his eyes paining and feeling hard, like pebbles; and "I can't stand the cold air. It is too strong." He sat with his hands to his face, explaining that he didn't want to look at the examiner because it would get him too excited. He was careless in dress and appearance, listless, with occasional times of excitement. His general condition was poor; a Wassermann test was negative. Frantz[8] reports that "It is evident that [he] is also suffering from dementia praecox."

The family history of these twin boys may be stated briefly. The father was about 60 years old when the twins first began to show the symptoms just described; he was an excitable but temperate man. The mother was of the same approximate age as the father and was healthy but nervous and excitable. Of the seven children born to these parents four girls were reported normal and one boy inclined to be nervous. The twins were the last of the seven to be born. Their grandparents had all died at rather advanced ages and from unknown causes. The parents had been married thirty-five years; there was no consanguinity; and the family history, so far as it could be ascertained, was negative. It is evident from these records that both twins when about twenty-one years old were suffering from dementia praecox and that they had first exhibited symptoms of this disorder within a little over a year of each other, J. S. in November, 1917, and I. S. in February, 1919.

Case II

In discussing the findings of the case just described with Dr. E. Stanley Abbot, formerly of the McLean Hospital, my attention was called by Dr. Abbot to a second case similar in many respects to that described by Frantz. In this instance, in which the twins were females, both have been inmates of the McLean Hospital. The following brief summary gives the essentials of Case II.

C. L. S. had grown increasingly deaf since childhood, the deafness not relieved by removal of adenoids at thirteen years of age. Following a severe attack of diphtheria when sixteen years old she occasionally talked to herself as though hearing voices. Though she was able to take two more terms at a private school, during the third the auditory hallucinations were more noticeable and she did not act normally. When nearly twenty, after a few weeks of mild neurasthenic symptoms, she rather suddenly became excited and noisy and was taken to a hospital. Since May, 1890, she has lived continuously in hospitals, including the McLean Hospital since December 28, 1909. During practically all this period she has talked but little, and that little has been mostly indistinct, incoherent, usually consisting of low muttering to herself. She has held no spontaneous communication with other patients,

and showed little interest in her mother when the latter visited her. Though sometimes crochetting or looking at pictures a little, with an amiable, placid expression, she has shown no sustained interest in anything and while so occupied has been liable suddenly and impulsively to destroy what was in her hands, or to jump up and tear or throw books, magazines, pictures, etc., to pound her own face or strike a nurse, or turn a picture face to the wall, then as quickly resume her placid state. She has shown many other habits and mannerisms, with latterly an increasing tendency to periods of rather prolonged excitement. Her case has been consistently diagnosed as dementia praecox.

E. T. S., twin sister of C. L. S., when sixteen years old, also suffered from diphtheria as her sister had. In 1890, a few months after C. L. S. had been sent to the hospital, E. T. S. suddenly became maniacal and suicidal and herself had to be taken to a hospital. She has been in hospitals ever since, at Butler Hospital for thirty years and at McLean Hospital since June 15, 1923. By the fall of 1892 she could not converse coherently, her memory was impaired, she "had no power of attention or appreciation," and was liable suddenly to scream and attack those about her. Gradually she got to occupying herself a little with picture books or cards. She often laughed to herself without obvious cause, apparently hallucinated. Following complete hysterectomy in 1902 her expression grew somewhat less strained and threatening and was often pleasant. She now rarely talks except in an incoherent way, muttering to herself. She is unoccupied, lying on a couch or sitting on a chair, paying little attention to what goes on around her. At all times since the beginning she has been liable to periodic outbreaks of noise and destructiveness, or other impulsive activity, such as tearing a picture from the wall, breaking a pane of glass, etc. Hers, too, is an unquestioned case of dementia praecox.

The family history of these twins showed that their paternal grandparents had died at advanced ages, the grandfather at 70 years from natural causes, the grandmother at 78 from kidney trouble. The maternal grandfather died at 83 years of age from natural causes and the maternal grandmother at 35 from puerpural fever. The father suffered a "sunstroke" about 1870, after which he was never well. He became hypochondriacal and later depressed and self-accusatory. He was admitted to the McLean Hospital April 17, 1874, and remained there till September 10, 1875. He occasionally talked of suicide. He has been in hospitals ever since. The mother to the time of her death a few years ago was reported in good health. She had had three children, a daughter born before the father's illness and now in normal health and the twin daughters born after the father's illness in 1870.

In commenting on the condition of these twins, Dr. Abbot writes that it is obvious from the records that the onset of the illness was very gradual and insidious in the case of C. L. S. and probably sudden and acute with E. T. S. There is the possibility, though not the probability, that E. T. S. had very mild, unrecognized symptoms before her violent outbreak. But, however this may be, it is certain that both twins by the age of nineteen or twenty had dementia praecox. In both there have been more or less frequent outbreaks of violence without obvious cause or motive. Each had certain mannerisms which were very suggestive of those of the other,—a close enough resemblance to be very striking to a physician who, knowing one, saw the other for the first time. Before E. T. S. was taken to the McLean Hospital, thirty-three years after the onset of her psychosis, the two twins had been in different institutions and had had no opportunity to see each other since the early stages of their illnesses.

Discussion

In dealing with the biological aspect of these two cases it is of prime importance to keep in mind that there are two distinct classes of human twins. In the first of these the two individuals are always of the same sex, both being males or both females. Such twins show at birth a single placenta and a single chorion. They are strikingly alike in appearance, having eyes and hair of the same color, similar complexions, and such other bodily configurations as to make them often indistinguishable even to members of their own families. Such twins are of frequent enough occurrence to be known to everyone; they are the Menaechmi and Dromios of everyday life.

–They were long suspected of being the product of a single egg, which, instead of producing only one individual, divided in the course of its development into two. This suspicion has been rendered almost a certainty by the recent observations of Arey[1] who has described a pair of such twins attached to a single yolk sac, an embryological condition scarcely explicable except on the assumption of a uniovular source. This belief as to the origin of such twins has been abundantly supported by what is known of the reproduction of armadillos. In the Texan armadillo, according to Newman and Patterson,[19,20] the four young produced at a birth are of the same sex, possess a common set of embryonic membranes, are strikingly similar in general configuration, and are the products of a single egg. As quadruplets they parallel exactly the condition of the class of human twins under discussion.[17,18] Such twins have been designated in the literature under various names: monochorionic, monozygotic, uniovular, homologous, similar, duplicate, and identical. I shall refer to them as identical twins.

The second class of twins may be of any combination of sexes, both males, or both females, or one male and the other female. They are almost invariably provided with separate foetal membranes and where such appears not to be the case, the condition gives evidence of a fusion of once separate parts. The similarities of such twins may be great or small and amount to the same as those seen between any two children born at different times in the same family. There is every reason for supposing that twins of this class arise from two independently fertilized eggs. They have been variously termed dichorionic, dizygotic, binovular, heterologous, dissimilar, fraternal, and pigeon twins. I shall use for them the term fraternal twins.

The young of most mammals that produce litters are like fraternal twins in that their numbers indicate the numbers of eggs originally fertilized. Identical twinning, however, does occur among other mammals than human beings, though apparently only rarely. It has been recorded by Assheton[2] in the sheep and Lush[11] reports a possible case in Brahma cattle. Evidence of it was not found in ordinary cattle by Gowen[8] and by Lillie.[10] The regular occurrence of a double duplication in the armadillo resulting in four offspring is of course analogous to identical twinning.

It must be evident from what has been said that in considering the mental diseases of human twins it is of first importance to ascertain whether the pair of twins are identical or fraternal. Since identical twins spring from the same egg they possess the same germinal composition and, so far as diseases having a germinal background are concerned, twins from such a source ought to show characteristic likenesses. Fraternal twins on the other hand have no greater claim to germinal similarity than any two children of separate births in the same family and consequently their mutual relations to disease are not to be expected as closer than those met with in the ordinary children of one family. From this standpoint the occurrence of dementia praecox in twins becomes an interesting biological problem. Are the twins

of Case I and Case II as described in this paper identical or fraternal twins?

Frantz in describing the first pair of twins mentioned in this paper made no statement on this particular. Consequently, after reading his account of the case, I wrote him a letter of inquiry. The fact that the twins were of the same sex was favorable to the interpretation that they were identical. As a result of their inaccessibility, a close comparison of the two was impossible, but through the kindness of Dr. Frantz a family photograph of the twins as young boys was obtained. This photograph was fortunate in showing two full-face views of them in which the striking feature was the remarkable similarity of their countenances. They exhibited the usual agreement seen in the faces of identical twins, and in consequence of this and of the further agreement in sex I am led to conclude that these twins are identical.

In the second pair of twins notwithstanding their relatively advanced age their similarity was most striking. Dr. Abbot was personally acquainted with C. L. S. as a patient at the McLean Hospital, but he had never seen her twin sister. On visiting Butler Hospital he saw E. T. S. for the first time, mistook her for C. L. S., and inquired as to a transfer of C. L. S. from the McLean to Butler, plans for which had been under consideration. He was greatly surprised to learn that the patient in Butler was not C. L. S. but her twin sister.

After E. T. S. had been taken to the McLean I had the opportunity of seeing both twins within the interval required to walk from one ward to another. They had the same color of eyes and the same kind of hair and, excepting that one was slightly more fleshy than than the other, they resembled each other most strikingly. Their similarity completely confirmed the opinion that the two women are identical twins. This case then is a second one in which the two members of a pair of identical twins have exhibited what is nothing short of a striking parallelism in their nervous states in that both have run similar courses with dementia praecox.

A search of the literature shows that these cases are not unique. Siemens[25], who has made a very careful survey of the pathology of twins, has noted seventeen recorded instances of dementia praecox (schizophrenia) among them. As this author remarks, it is not always easy to discover from the account set down by the reporting physician whether a given case is that of identical or of fraternal twins. But of the seventeen pairs noted six from internal evidence were without doubt identical, five were less certainly so, and six were probably fraternal. Of the six unquestionably identical pairs the sex of only four were given; in three the individuals were males and in one female. This shows, as the cases reported in the present paper do, that dementia praecox in identical twins is not limited to one sex. The appearance of the disease is described in three of the six cases recorded by Siemens as simultaneous for each given pair and a year apart in a fourth pair. In the remaining two the records are in this respect deficient. The closeness of onset in those instances where the time of occurrence is given agrees very well with what has been recorded for the two cases described in the present paper.

The general agrement in this total of eight pairs of identical twins points at once to the importance of such pairs in the study of nervous diseases. Any pair of such twins has a common organic inheritance and this condition is attested by their striking similarity. Their differences must, therefore, be due to environment. Hence they afford an unusual opportunity, as was long ago pointed out by Galton[7], of distinguishing those traits that are handed on through the germ from those that are produced by the surroundings.

In the past it has been usual in discussing human conditions to attribute much, often very much, to the envi-

ronment, but no one can study a pair of identical twins, particularly those that have been brought up separately and under different conditions, without being profoundly impressed with the immense importance of the germinal inheritance. This it is that is chiefly responsible for that similarity in identical twins that makes them often indistinguishable even to their close associates. That they should dress alike is without doubt chiefly due to the environment, but that their countenances should be indistinguishable is germinal. Galton[7] (p. 226) mentions the case of two twins who at the age of twenty-three were attacked by toothache and the corresponding tooth had to be extracted from each one. Many such cases are probably pure coincidences which have been remembered and recorded because of their striking relations. It is, however, entirely possible that, trivial as some of these relations may be, they may after all have a germinal background. The simultaneous occurrence in identical twins of children's diseases, such as chickenpox and the like, is probably quite as much an environmental affair as a germinal one, but with the occurrence of dementia praecox in such twins the evidence is strongly in favor of a germinal source, for this disease, so far as I am aware, has never been attributed to infection. It appears to arise from a germinal taint, a maladjustment in the egg cell or the sperm cell or in both, and its simultaneous occurrence in identical twins, as pointed out in this paper, is strongly in favor of its germinal origin. That it should also occur in pairs of fraternal twins, as noted by Siemens[25] is no argument against this view, for, if it is germinal in nature, it may well be expected in any of the members of a given family. What would be of great interest in this connection would be the discovery of cases of dementia praecox in identical twins in which only *one* twin was affected. I know of no such instances, but the absence of them in the literature may be due to the fact that their importance is only now first being recognized and hence they may have been unnoted by the older observers.

The conclusion arrived at in this paper—that dementia praecox is germinal in origin—is quite in line with what has been maintained within recent years about this disease and agrees in general with the conclusions contained in many recent publications.*

Perhaps it is premature to declare, as Rosanoff[22] has done, that dementia praecox in a Mendelian recessive as compared with the normal state, but with so competent a worker as Rűdin[24] supporting much the same declaration, the view is bound to be considered seriously. From the standpoint of the cases presented in this paper the germinal nature of the disease seems reasonably certain and this is quite in line with the statement of so conservative a writer as Myerson[16] (p. 215), who declares that dementia praecox "breeds true." From a practical standpoint the occurrence of this disease in one of a pair of twins should lead the attending physician to an immediate examination of the other twin. The importance of any kind of remedial measure in this disease must be evident from statements such as those recently made by May[12] (p. 460) to the effect that approximately 120,000 persons are now suffering from dementia praecox in institutions in the United States and that their maintenance is costing the community about $25,000,000 annually.

Literature Cited

1. Arey, L. B. 1922. Direct Proof of the Monozygotic Origin of Human Identical Twins. *Anat. Rec.* 23:245-251.

2. Assheton, R. 1898. An Account of a Blastodermic Vesicle of the Sheep of the Seventh Day, with Twin Germinal Areas. *Jour. Anat. Physiol.* 32:362-372.

*See Meyer, Jelliffe, and Hoch,[13] Rosanoff and Orr,[23] Rosanoff,[22] Rüdin,[24] Kraeplin,[4] Bleuler,[3] Siemens.[25]

3. Bleuler, E. 1924. Textbook of Psychiatry. New york.
4. Danforth, C. H. 1919. Resemblances and Differences in Twins. *Journal of Heredity*. 10:399-409.
5. Fairchild, D. 1919. Twins. *Journal of Heredity*. 10:387-396.
6. Frantz, M. H. 1919. Dementia Praecox in Twins. *Jour. Nerv. Ment. Disease*. 50:325-330.
7. Galton, F. 1883. Inquiries into Human Faculty and its Development. New York
8. Gowen, J. W. 1922. Identical Twins in Cattle. *Biol. Bull.* 42:1-6.
9. Kraepelin, E. 1919. Dementia Praecox and Paraphrenia. Edinburgh.
10. Lillie, F. R. 1923. Supplementary Notes on Twins in Cattle. *Biol. Bull.* 44:47-78.
11. Lush, J. L. 1924. Twinning in Brahma Cattle. *Journal of Heredity*. 15:25-27.
12. May, J. V. 1922. Mental Diseases. Boston.
13. Meyer, A., S. E. Jelliffe and A. Hoch. 1911. Dementia Praecox. Boston.
14. Muller, H. J. 1925. Mental Traits and Heredity. *Journal of Heredity*. 16:432-454.
15. Murray, G. R. 1925. A Study of Twins in Health and Disease. *Lancet*. 208:529-532.
16. Myerson, A. 1925. The Inheritance of Mental Diseases. Baltimore.
17. Newman, H. H. 1917. The Biology of Twins. Chicago.
18. Newman, H. H. 1923. The Physiology of Twinning. Chicago.
19. Newman, H. H. and J. T. Patterson. 1909. A Case of Normal Identical Quadruplets in the Nine-banded Armadillo, and Its Bearing on the Problems of Identical Twins and of Sex Determination. *Biol. Bull.* 17:181-187.
20. Newman, H. H. and J. T. Patterson. 1910. The Development of the Nine-banded Armadillo from the Primitive Streak Stage to Birth; with Especial Reference to the Question of Specific Polyembryony. *Jour. Morph.* 21:359-424.
21. Popenoe, P. 1922. Twins Reared Apart. *Journal of Heredity*. 13:142-144.
22. Rosanoff, A. J. 1913. Dissimilar Heredity in Mental Disease. *Amer. Jour. Insanity*. 70:1-105.
23. Rosanoff, A. J. and F. I. Orr. 1911. A Study of Heredity in Insanity in the Light of the Mendelian Theory. *Amer. Jour. Insanity*. 48:221-261.
24. Ruedin, E. 1916. Studien ueber Verebung und Entstehung geistiger Störungen. I. Zur Verebung und Neuentstehung der Dementia Praecox. Monographie. Berlin.
25. Siemens, H. W. 1924. Die Zwillingspathologie. Berlin.
26. Wiggam, A. E. 1923. Twins Again. *Journal of Heredity*. 14:311-322.
27. Wilder, H. H. 1919. Physical Correspondences in Two Sets of Duplicate Twins. *Journal of Heredity*. 10:410-420.
28. Woods, F. A. 1919a. Twins Prove the Importance of Chromosomes. *Journal of Heredity*. 10:423-425.
29. Woods, F. A. 1919b. A Definition of Heredity—"Nature vs. Nurture" Not a Good Expression. *Journal of Heredity*. 10: 426-427.

Health in the School

Health Through Prevention and Control of Disease, *by* Thos. D. Wood and H. G. Rowell. Pp. 122. Price $1.10. World Book Co. 1925.

A book intended for teachers, and school officials, school physicians and school nurses but also of value to parents, and for study in parent-teachers' associations. The authors state:

> The school, from its very nature, is completely constituted to act is a disease center, assembler and distributor of children's disease in the community. Efficient application of the best knowledge of *disease prevention* is indispensable to the task of making the school a successful center of health control and health influence.

The emphasis on the nature of colds as diseases, and the concise, clear, and authoritative statements of the important facts regarding contagious diseases will be useful in every home. A definite and simple statement of individual differences in susceptibility or resistance to disease, arising from the genetic constitution of the individual, would appear to have been worth while. This would furnish a background for an understanding of the spread of diseases, of reaction to vaccination and to the diphtheria and scarlet fever tests,—of the danger of the typoid carrier.

G. M. D.

EXPERIMENTS ON THE GROWTH OF POPULATIONS

A Review

FROM a survey of the many fields of human activity extending over the past several centuries Dr. Pearl arrived at the conclusion that one of the direct results of prolonged warfare is a general awakening of public interest in questions of population.

Having full confidence in this conclusion it was but natural that he should anticipate a similar interest in population following the recent war and set about to stimulate it. Two books have resulted from these efforts, the first having received attention previously[1]. The publication of these books affords an admirable example of applied biometry and it is to be hoped that their sale will encourage the author to continue to peer into the future.

The more recent book has been carefully considered from the standpoint of the general reader and every effort made to eliminate matter likely to fatigue the minds of this important section of the book-buying public.[2] The collection of tabular and reference matter into an appendix is a negative virtue but positive attractions have not been omitted and the reader is assured that the author has a well-thumbed edition of Rabelais, so that in this particular the present book is all the most robust could desire.

Of the vast number of books on population this is one of the few that approaches the problem in a truly scientific manner. It will appeal, of course, to all those interested in the growth of populations but it is to be hoped that the audience will be even wider. The ingenious methods followed and the courage with which the transition is made from flies to man and the reverse should interest many people who are not concerned about the remote future and who have no faith in predictions.

It is seldom indeed that an investigator, even if able, will take the trouble to present his results in a manner so easily understandable to the layman and the sale of this book should provide an index of whether the effort is worth while.

Briefly Dr. Pearl's thesis is that the growth of human populations follows the same general principles as the growth of any group of lower organisms or of any aggregation of cells, such as those composing the human body. In general the increase in numbers, whether of humans or cells, is slow at first, rises with increasing rapidity until the saturation point or maturity is attained at which time stability is reached and no further increase takes place, the rate flattening out.

The curve of population growth thus roughly approximates the letter S and the conclusions as to the similarity of growth in diverse organisms depends upon the accuracy with which the rate of growth can be fitted by formulae to curves of this nature.

Dr. Pearl can not be accused of basing his conclusions on too few cases since he presents evidence on the growth of yeast cells, the fruit fly, rats, pumpkins and the populations of many nations. The growth

1. *Journal of Heredity*, Vol. XVI, No. 4, p. 145.
2. PEARL, RAYMOND. The Biology of Population Growth. Alfred A. Knopf. 1925. $3.50.
3. WRIGHT, SEWALL. Correlation and Causation. *Journ. Agri. Res.*, Vol. XX. No. 7, pp. 557-585. January 3, 1921.

rates of these diverse materials are cunningly fitted to S curves and are very convincing. In considering the future size of populations as indicated by the projections of the curves the reader should bear in mind that others skilled in this art of curve fitting and using the same raw data have arrived at different end figures. These different interpretations in no way invalidate the basic principles but leave to the reader a certain latitude of choice of procedure as to whether something should be done at once, to curtail excessive numbers, or whether action can be deferred safely to future generations. A further limitation of this sort of analysis must be kept in mind, namely that the future growth of a population may be altered at any time by the operation of new economic or social factors.

No effort is made to conceal these limitations and the book is in no sense just another addition to the propaganda aimed at stilling the rising tides of chromatic populations.

The native population of Algeria has furnished, in comparison with the French colonists, some highly significant facts. By fitting the curve of growth of the native population to a logistic curve it is seen that this population is at the upper limit of its numbers under existing conditions.

For the period 1901-14 (limited by the war) it is seen that the death rate and the birth rate of the indigenous population are declining steadily. Evidence is presented to show that this slackening death rate is not due to hygenic measures established by the French. From the innate conservatism of the people and their general indifference to the welfare of the women it is argued that the falling birth rate is not due to artificial limitations. This line of argument does not carry much weight since the women of many uncivilized peoples understand contraceptive measures and are capable of self protection. But Dr. Pearl does not lean too heavily on logic, and ingeniously turns to fruit flies and chickens for additional evidence. No one can urge that either fruit flies or chickens practice birth limitation measures yet with a circumscribed universe an increase in population is accompanied by a decline in the number of young born per female. This lowering of the birth rate can not be ascribed to a shortage of food or space since both were ample in the less populous end of the experimental series, yet it was at this end that the birth rate declined most rapidly.

A curious paradox is presented by this situation. Thus as a population becomes dense the birth rate declines whether the population be of fruit flies, chickens, Algerians or Americans. With humans it is equally clear that poverty and high birth rates go hand in hand yet surely poverty increases with the increase in population.

The least satisfactory and convincing chapter in the book has to do with partial correlations involving indices. Those familiar with the calculations of partial correlations will not take too seriously, as a true measure of the influence of density of population per acre on birth rate, the coefficient of $-.175 \pm .057$ with the population, wealth, school attendance and persons per dwelling, constant. In view of Wright's serious criticism of the method of partial correlations for such complex relationships the method of path coefficients would seem to be applicable to problems of this nature.[3]

The author holds no brief for those who would have us believe that there is a heritable gene for poverty or that the rich are mentally superior.

At the same time it is apparent that the poor have too many children and the suggestion is made that for their own welfare and for that of the world in general it would be an advantage if methods of birth control were made available for every one. The poor man is conceived not as diabolically adding more and more children to the population of the

world but rather as the victim of circumstances which leave him no form of nervous outlet other than the sexual.

There are the customary interesting by-products that one has come to associate with the author's investigations and the reader will learn much of the habits of the natives of Algeria together with the effects of French administration. Coming nearer home the reader will gain an added respect for the farmer coupled with a certain impatience at this worthy's reputed dissatisfaction with his emoluments.

The reading of the book will be completed with the conviction that the population of the world is increasing at such a rate as to make the existence of our not too distant offspring more rigorous than our own. Although the world's future population will be composed very largely of the descendants of the present day poor this by no means indicates that the mental level of the people of the future will be lower than at present so that anyone inclined to worry over such matters may be reassured.

And finally the author has no sympathy with the calamity howlers as witness this paragraph following a discussion of the inevitableness of population increase:

> Will this process necessarily increase the sum total of human misery and wretchedness in the world, as we are told it will? I used to think so, but the longer I have pondered over the matter the less sure I feel about this conclusion. I think the thing which first made me dubious about this inevitable misery doctrine was its seemingly compelling logic. It was so easy to prove logically that it must be so that I began to be suspicious that in fact it probably was not so at all. Long experience with experimental work has taught me that a somewhat rough and ready, but on the whole dependable, rule is that any natural phenomenon which, in advance of observation of the event, can be proved by purely logical processes to be necessarily so, almost invariably turns out upon really competent and penetrating trial or observation to be in fact not so at all but quite otherwise.

J. H. Kempton.

The Eugenics of the City

The eugenics of the city is of especial importance, for it is in the city that the marriage rate and the birth rate of the intellectually superior are far lower than the marriage and birth rate of the less intellectual. In the country there is much less difference between the marriage rate and birth rate of the superior classes and inferior classes. The two greatest needs to rectify this damage are, first, a more even distribution of effective means of birth control; for today, the means employed by the intellectually inferior are, on the whole, inefficient, since a wide, quick distribution of the best methods now known by a few are hampered by restriction of a harmful law.

The second factor lies in the lack of a social disapproval of the sub-fecundity of superiors. Much of this indiscriminating attitude can be attributed to the failure of our dominant religions to teach the ethics of reproduction. There is great insistence on chastity and this is carried so far as to give approval to celibacy. On the contrary, no emphasis is laid on the social need of adequate families of superior stock. Before the days of the voluntarily limited family, which dates mostly from 1877, there was no great need for an ethic of reproduction, but now it is our crying need, and the interesting problem arises: Can religion fill the gap? If not, what can? Or must the city continue its sorry role of racial degeneration?—Roswell H. Johnson, in *Journal of American Sociological Society.*

NEWS AND NOTES

Plant Science Conferences

TWO important conferences of interest to members of the A. G. A. are to be held this coming August. The International Conference of Plant Science will be held at Ithaca, New York, August 16 to 23. Mr. B. M. Duggar, Missouri Botanic Garden, St. Louis, Mo., is chairman of the organizing committee, to whom inquiries may be directed.

Just preceding this, August 12 to 14, a three-day conference on "Flower and Fruit Sterility" has been announced by the New York Botanic Garden. Dr. A. B. Stout is Secretary of the conference committee. The following statement of this committee sets forth the purpose of the conference:

SCOPE: The Conference will consider the phenomena of sterility and fertility in fruit and seed production with special reference to (a) the breeding of floricultural plants, (b) problems of fruit growing and seed production in horticultural and agricultural crops, and (c) botanical and genetical aspects of sterility and fertility.

CHARACTER OF THE SESSIONS: It seems desirable to hold a three-day Conference with one day devoted to the interests of florticulture, one to the problems of fruit growing, and one to the more purely scientific aspects of the subject. There will be invitation papers of the symposium type with shorter and more special contributions as offered. It is planned to have invitation papers presented especially by several noted horticulturists, botanists, and geneticists from Europe.

Further notices regarding this Conference will be made from time to time. An effort will be made to reach all who are interested in the subject.

The cooperation of all who are interested in this Conference is requested. The Committee is now ready to receive titles of papers and an early report from those who plan to attend and particularly from those who wish to present papers is requested.

Plan to Establish Llamas Here Highly Speculative

"HOPE springs eternal," and this time in the breast of a western enthusiast who plans to import the South American llama and alpaca and establish these hardy and hairy animals as a part of our livestock husbandry. It is not a new idea. Numerous attempts to do the same thing have been made during the past 100 years, says the United States Department of Agriculture, and all have failed.

In reply to an Inquiry, Dr. J. R. Mohler, chief of the Bureau of Animal Industry, recounted the history of several former importations. Added to the troubles experienced in these early ventures, he said, is a new one—quarantine restrictions against importing animals from countries where certain diseases are prevalent.

Official reports indicate, he wrote, that foot-and-mouth disease is prevalent in most countries of South America, including those regions in which llamas are commonly found. The department issues no permits for the importation of ruminants and swine from countries in which this disease exists and, accordingly, the bars are up against llamas and alpacas from Peru. They can be imported only from countries free of the disease, where they may be found in zoological parks or similar places.

In his report for 1857 the Commissioner of Patents published a chapter on the llama and alpaca in which he stated that for a period of nearly 40 years the subject of introducing them had been agitated, and that several attempts had been made to engraft

them into our husbandry. The American Agricultural Association of the City of New York, raised a fund for an importation in 1846; a present of several of them was made by the Peruvian Government to the Hon. Daniel Webster, when Secretary of State. But owing to the apparent inadaptability of these animals to the climate and elevation of the Atlantic and Gulf States, all experiments proved futile, said the report.

In the early part of 1904 the department made arrangements to admit a shipment under quarantine for parties in Colorado but the venture apparently was not carried out. 'Any attempt which may be made by the newest enthusiast to introduce llamas into the United States on a commersial scale and raise them for meat and wool, says Doctor Mohler, will be highly speculative. — *U. S. Dept. Agr. Clip Sheet.*

Live Stock Show at Philadelphia Sesqui-Centennial

PLANS for a great Live Stock show of national proportions have been announced by officials of the Sesqui-Centennial International Exposition which opens in Philadelphia June 1. The show will be held on the Exposition grounds the week of September 12 to 19 and will bring to the Sesqui-Centennial the pick of breeders' stock throughout the country.

Prize money for the finest breeds amounting to $50,000 will be offered by the Exposition. Additional prizes to be contributed by the various Live Stock Registry Associations who are collaborating with the Exposition in putting on the show is expected to swell the amount to approximately $75,000.

The Live Stock Associations plan to bring more than 3,200 head of stock divided as follows: Cattle, 8 breeds; draft horses, 4 breeds, sheep, 10 breeds, and swine, 5 breeds.

Pens and tent stalls will be put up in the rear of the palace of Agriculture where proximity to the railroad tracks will facilitate loading and unloading of live stock cars. More than 200 cars are anticipated. For each of the breeds represented the corresponding Registry Association will put at the service of the Exposition its entire organization to insure a show of the highest rank and caliber. In fact, the entire live stock industry of the country are planning to back the show with its prestige that it may be one of the greatest ever held in the east. Canadian cooperation will also be sought and the show committee believe it probable that breeds from the Dominion will be fairly represented.

A Class in Matrimony

A COURSE, designed primarily for the young man contemplating matrimony, has been included among the courses offered by the Y.M.C.A. of Jersey City. "The aim of the course," states the catalog, "is to impart instructive knowledge to prospective bridegrooms and others, with the idea of preventing mistakes rather than attempting to cure them. Few men are really prepared physically and mentally for the state of wedlock, if we may believe what physicians and judges say nowadays. Every red-blooded man in Hudson County, between twenty and thirty years of age, should enroll now—not for his sake alone—but for hers also."

The program, which is planned for weekly meetings covering two months, includes talks by Dr. Max J. Exner

on "The Role of Sex in Human Life"; by Mr. Newell W. Edson on "Appetites and Their Right Use"; and by Dr. Eugene L. Swan on "Sexual Knowledge a Father Should Impart to His Son." Local physicians have been called upon to give most of the other lectures, which include such topics as "Who Should Marry—Eugenically?" and "How a Woman Looks Upon Marriage." — *Social Hygiene News,* January, 1926.

American Eugenics Society on "Certified Families."

Editor, Journal of Heredity:

THE American Eugenics Society thanks you for the notice regarding the Fitter Families Contests which appeared in the February issue. I hope that your readers will realize that this article was one written for a farm paper. We eugenists are constantly accused of making eugenics into a sort of breeding farm proposition, and I hope that this article did not give anyone that impression. The reason I used so many illustrations of live stock was because I was talking in the language of the farmer about things which he understood. There is one error on Page 69. As I remember it, the 17,000,000 should be 17,000,000,000 ancestors, but no doubt the Grand Rapids Herald made a mistake in copying this.

In regard to certified families I am sending you a clipping from the Philadelphia Bulletin which is a letter I wrote them after an editorial by them on certified families had appeared. You see the American Eugenics Society has no intention whatever of certifying families and this idea was spread by a reporter who apparently misinterpreted a paper read at meetings at the American Association for the Advancement of Science in Kansas City this past year.

Very sincerely yours,

LEON F. WHITNEY,
Field Secretary.

To the Editor of The Bulletin:

I have had called to my attention an editorial which appeared in your paper on February 6, called "Pedigreed Piffle."

I am sure that you must have been misinformed about the proposal of the Eugenics Society to certify families. Such a proposition would be ridiculous on the face of it, and nothing that I can think of would react more unfavorably against the Eugenics Society than to undertake something of this kind.

I presume that you have reference to the Fitter Families contests which have been held at seven agricultural fairs throughout the United States this year. A large part of the basis for the hereditary qualifications is what the family itself tells the judges about itself. Of course, it is urged upon them to drag out the family skeletons as well as to name the sterling qualities in their ancestors. You see, therefore, that it would not be possible to certify a family on what it says about itself, and at such a contest as we are able to hold it is not possible to carry on a eugenical investigation of each family history. The families are examined for their physical condition, their degree of mentality, in so far as that is ascertainable, by an up to date mental test. These two items together with the hereditary part are the basis for the awards and medals which are given by the American Eugenics Society.

There is no intimation whatever that these families which receive prizes are certified families. All that we can say and all that we desire to say is that this particular family won the prize because an average of their heredity, mentality, and physique seemed to be the highest of any of the families which competed. Beyond that we would not care to go.

The object of these contests is not to certify families but to interest them in heredity. We make it an especial point to interest the children, and the largest part of the effort is spent on the fact that there is but one way to raise the hereditary qualities of their family; namely, by marrying into families where there are none of the same kind of skeletons which their family has hanging in its closet. We also try to show the children that when they marry they select half of the ancestors of their children.

Surely there is nothing un-American in a scheme which would tend to make the heredity of America even one fraction of a degree higher by its educational value. The

majority of the families who have taken the examination have been city people and a splendid type they have been.

I hope that Pennsylvania will have one of these contests next year and that you and all of your readers may have an opportunity to learn how much benefit it can be to a community. I hope also that you will disillusion your readers' minds of the impression that the American Eugenics Society has any idea of certifying families.

LEON F. WHITNEY.

Order of Birth Unimportant in Achieving Fame

Whether you are a first child or a 15th does not affect your chances of greatness, according to Dr. Wilhelmina E. Key, who recently reported to the Eugenics Research Association the results of her statistical studies of eminent persons.

Dr. Key, according to Hygeia, wanted to learn if there was any scientific basis for the popular notion that the eldest child has the best chance of obtaining prominence. She studied the family records of many famous Americans, from Alexander Hamilton to Augustus Saint-Gaudens and Mark Twain and her conclusions were that the order of birth in a family has nothing to do with their achieving fame.

James Fenimore Cooper was the 11th of 12 children. General Sherman came in the middle of a large family. Dr. Key's studies seemed to indicate that the regular law of averages was at work when it came to position in family and in world affairs.

Bronx (N. Y.) Home News—Dec. 27, 1925

"Eugenic" Marriages in Turkey

Constantinople, Jan. 9.—Eugenics is to have a part in creating the civilization of the new Turkey. The Governor of the Province of Constantinople, after a conference with the health authorities, has framed an order requiring medical examination of applicants for marriage licenses.

Associated Press.

Seed Potato Buyers Victims of Varietal Substitution

POTATO growers who purchase seed potatoes do not always get the particular varieties they order. There is so much substitution of varieties by seed potato dealers that the growers are seeking the passage of control measures which will correct the evil. Substitutions, either careless or willful, are more apt to be made, says William Stuart, potato specialist of the United States Department of Agriculture, for the newer or less known varieties. Purchasers who order "fancy names" or "new and highly advertised" varieties are more likely to be victimized, he says, than those who stick to the widely known varieties.

Mr. Stuart ordered 139 different varieties last year from 61 different seedsmen. Many firms replied that they were "just out" of that particular variety. Of the 98 named varieties that were received, 25 per cent proved to be varieties other than those specified in the order. In one instance, three varieties were ordered from a dealer advertising himself as "reliable." Three different packages were received all of which proved to be the same variety, but not of any one of the three varieties ordered.